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**HEALTH & SAFETY PLAN
(ACCIDENT PREVENTION SAFETY PROGRAM PLAN)
ROCKY FLATS PLANT PHASE II RFI/RI 903 PAD,
MOUND, AND EAST TRENCHES AREAS, (OPERABLE UNIT 2)
ROCKY FLATS PLANT
APRIL 1991
CONTRACT NO. BA71956 PB
VERSION 0.0**

WCFS Project No. 4006
WCC Project No 22567E

Prepared by

WOODWARD-CLYDE

(4006-115-38)(11425.COV)(14/23/91)

REVIEWED FOR CLASSIFICATION/LICN

By

J. A. Nisham NU

Date

06-06-91

ADMIN RECCRD

BZ-A-000515

1/382

EMERGENCY TELEPHONE NUMBERS

Site Health and Safety Officer Gregg Miller	(303) 966-5874
Business Unit Health and Safety Officer Mike Sams	(303) 740-2700
WCFS Corporate Manager, Health and Safety Jerry Andersen	(303) 740-2700
24-Hour Installation Health/Safety Coordinator	(303) 966-2911
Fire	(303) 966-2911
Ambulance	(303) 966-2911
Poison Center	(303) 629-1123
Security	(303) 966-2911
Police	(303) 966-2911

THE W-C TRAILER IS LOCATED AT: 901 Contractor's Pad, Trailer No 22

**NEAREST MEDICAL
SERVICES ARE LOCATED AT: Building 122**

Directions:

From the Contractor's trailer compound, take a northbound street to Central Avenue and turn left onto Central Avenue: Building 122 will be on the left side and slightly west of a guard building on the right after approximately 1.25 miles.

From the RFP eastern boundary, upon entering RFP off of Indiana Street, you will be on Central Avenue. Proceed approximately 3.5 miles. Building 122 will be on the left side.

From the RFP western boundary at Hwy. 93, proceed along the entrance road to just past the second gate, at which time you will be east bound on Cactus Avenue. Then turn left onto the first street past Second Street, (Third Street which is not marked). Proceed up Third Street past Building 125, which is on the left: the next building on the left will be the medical facility (Building 122).

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- ACETONE
- CARBON DISULFIDE
- CARBON TETRACHLORIDE
- CHLOROFORM
- 1,1-DICHLOROETHANE
- 1,1-DICHLOROETHYLENE (SYNONYM: VINYLIDENE CHLORIDE)
- DI (2 ETHYLHEXYL) PHTHALATE (SYNONYM: BIS (2 ETHYLHEXYL)
PHTHALATE
- ETHYL BENZENE
- ETHYLENE DICHLORIDE (SYNONYM: 1,2-DICHLOROETHANE)
- METHYL CHLOROFORM (SYNONYM: 1,1,1-TRICHLOROETHANE)
- DIPHENSYLNITROSAMINE (SYNONYM: N-
NITROSODIPHENYLAMINE)
- TETRACHLOROETHENE (SYNONYM: PERCHLOROETHYLENE)
- 1,1,2,2-TETRACHLOROETHANE
- TRICHLOROETHYLENE (SYNONYM. TRICHLOROETHENE)
- VINYL CHLORIDE
- TOTAL XYLENES

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- OPERATING PROCEDURE NO. HS-203, RESPIRATOR INSPECTION, CARE,
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- OPERATING PROCEDURE NO. HS-501, PERSONNEL DECONTAMINATION
- OPERATING PROCEDURE NO. HS-509, SAFETY GUIDELINES FOR
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- OPERATING PROCEDURE NO. HS-510, SAFETY PROCEDURES FOR
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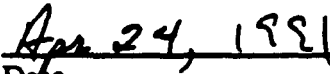
1.0
PROJECT IDENTIFICATION

Project Name:	Phase II RFI/RI 903 Pad, Mound and East Trenches Areas (Operable Unit 2)
Project Number:	Woodward-Clyde Federal Services (WCFS) 4006 Woodward-Clyde Consultants (WCC) 22567E
Project Location:	Rocky Flats Plant Jefferson County, Colorado
WCC Administrative Operating Unit:	Denver ESE
WC Operating Group:	Central
Project Manager:	Alan F. Claybourn
Author of the Plan:	William M. Sams
Effective Dates:	March 1, 1991 through December 31, 1992

APPROVALS



William M. Sams
Author



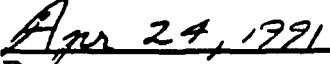
Date

Alan Claybourn, PE
Project Manager

Date



Jerry Andersen, PE, CIH
Corporate Manager, Health and Safety



Date

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This Health and Safety Plan presents health and safety requirements and guidelines for performance of the work required for implementation of the Phase II RFI/RI Work Plan for the 903 Pad, Mound and East Trenches Areas at the Rocky Flats Plant (RFP). It is in compliance with applicable sections of 29 CFR 1910.120 and was prepared exclusively for use by employees of Woodward-Clyde (W-C) and its subcontractors. This plan shall not be modified or used after the expiration date without written approval by the Project Manager (PM), Health and Safety Officer (HSO), and Corporate Manager, Health and Safety (CMHS). In addition, this plan shall not be used by firms or persons not under contract to W-C without written approval by W-C's Executive Vice President-Practice. This plan is not valid until it is signed and dated by the Author, PM, and CMHS. Any modifications to this plan must be approved by the individuals signing on the title page or by their representatives.

The project's location in relation to the Denver area is shown in Figure 1-1, Location Map. Figure 1-2, RFP General Map, shows the boundaries of RFP, and Figure 1-3, RFP - Facilities Map illustrates the developed area of RFP.

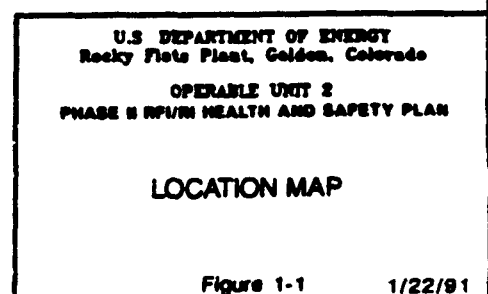
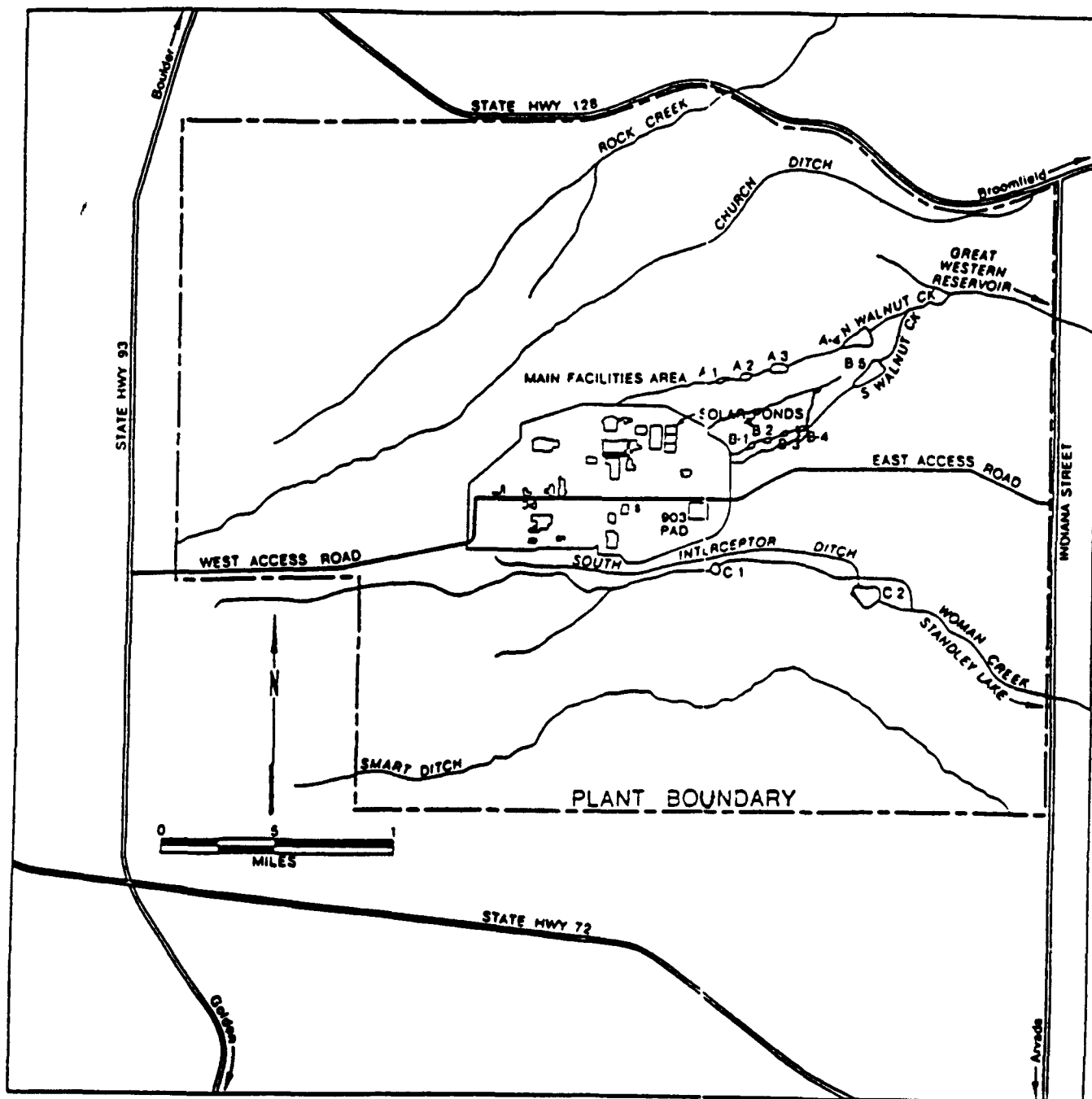


Figure 1-1 **1/22/91**

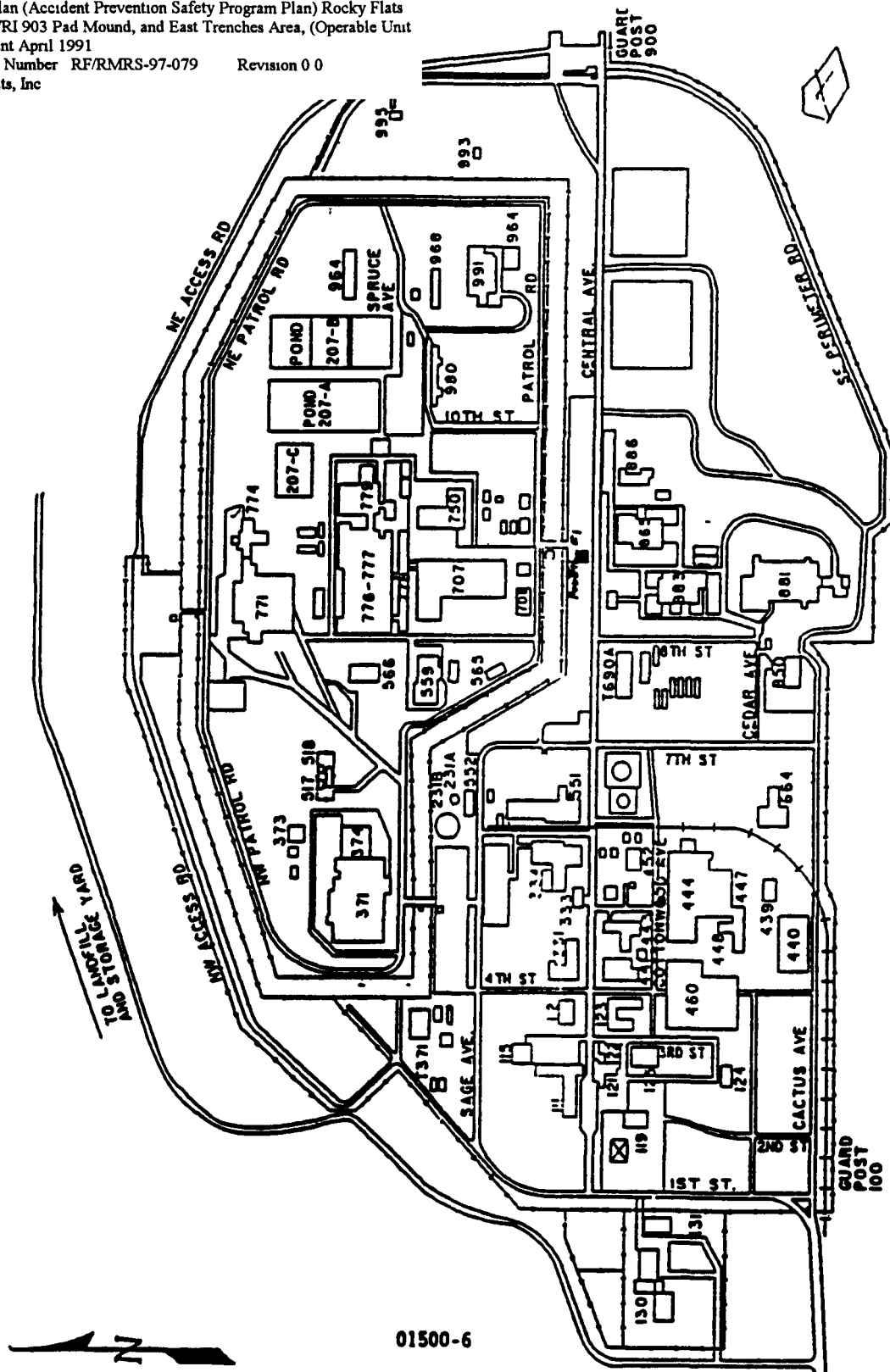


U.S. DEPARTMENT OF ENERGY
 Rocky Flats Plant, Golden, Colorado
 OPERABLE UNIT 2
 PHASE II RFI/RI HEALTH AND SAFETY PLAN

RFP - GENERAL MAP

Figure 1-2

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2.0 STAFF ORGANIZATION

This section describes project staff organization, with regard to the roles of the various positions on this project as they pertain to health and safety. The responsibilities and authority of each subcontractor individual with a role in health and safety administration are presented in Table 2-1. The responsibilities of RFP individuals with a role in health and safety are presented in Attachment L.

W-C and W-C subcontractor personnel who have been identified as having a potential for being involved in the Operable Unit 2 field activities are listed below. Others will be identified as activities progress.

- | | | |
|----------------------|------------------------|----------------------|
| • Andersen, Jerry J. | • Fleming, Richard L. | • O'Brien, James P. |
| • Bell, Richard | • Glasgow, Willard | • Owenby, Robert K. |
| • Bender, Joseph | • Hencmann, Robert | • Pacheco, Ken |
| • Bender, Patricia | • Holmes, Ron | • Ryan, Mike |
| • Bender, Daniel R. | • Hosey, Bert Lee | • Rupp, Richard J. |
| • Bianco, Ed | • Jehn, John | • Rupp, Robert L. |
| • Brooman, David L. | • Jones, Chuck | • Sams, William |
| • Bufo, David | • Jubenville, David M. | • Silva, Roderick W. |
| • Burgess, Dan | • LaRue, Bruce | • Schreiber, Mike |
| • Claybourn, Alan F. | • Lahn, Robert | • Shuey, Steven |
| • Conner, Darrel | • Mast, Edward | • Spruce, David |
| • Cox, Jeff | • May, Michael | • Terry, Tom |
| • Dal Lago, Ed | • McGee, Gary Gale | • Trimbach, Kent |
| • Doherty, John | • Merrel, Harvey | • Van Santen, Luke |
| • Durand, Roy L. | • Miller, Greg | • Wilson, Robert |
| • Durand, Thomas K. | • Miyoshi, Kerry | • Wigel, Matthew |
| • Erwin, Larry | • Montgomery, Brian | • Zitek, James |

Personnel to be assigned to field activities must be approved by the Site Safety Officer (SSO) or HSO before commencing with field work at RFP.

TABLE 2-1

RESPONSIBILITIES AND AUTHORITY OF HEALTH AND SAFETY PERSONNEL

VICE PRESIDENT-PRACTICE (VPP) D. Connors

Responsibilities

- Direct and monitor the implementation of the health and safety program.
- Advise the president on health and safety matters.
- Issue directives, advisories, and information to the WCFS Corporate Manager, Health and Safety (CMHS).
- Advise the CMHS on policy, liability, and professional practice issues

Authorities

- Direct changes in the health and safety program.
- Determine and implement personnel disciplinary actions, as required.
- Review and approve the WCFS corporate health and safety budget.
- Approve and audit corporate health and safety expenditures.

CORPORATE MANAGER, HEALTH AND SAFETY (CMHS): Jerry Andersen

Responsibilities

- Track health and safety regulations and implement improvements to the WCFS health and safety program.
- Ensure records are maintained pertaining to medical surveillance, training, fit testing, chemical exposure, and incidents.
- Update health and safety manual.
- Manage medical surveillance program.
- Ensure health and safety training is obtained.

TABLE 2-1
(Continued)

-
- Provide industrial hygiene/chemical safety guidance to WCFS HSOs.
 - Audit key aspects of health and safety program and report effectiveness to VPP
 - Coordinate health and safety activities of the business unit offices.
 - Investigate reports of incidents or accidents and report accidents or incidents to the VPP.
 - Coordinate a mutually beneficial cooperation with the WCC Health and Safety Administrator.

Authorities

- Approve the qualifications of employees to work at hazardous waste sites
- Approve health and safety plans.
- Establish employee training and medical surveillance procedures.
- Suspend work on any project that jeopardizes the health and safety of personnel.
- Access project files to perform health and safety audits or investigate accidents/incidents.
- Remove individuals from projects if their conduct jeopardizes their health and safety or that of coworkers.
- Approve the appointments of business unit HSOs.
- Perform audits of office and/or field Health and Safety Activities.

BUSINESS UNIT HEALTH AND SAFETY OFFICER (HSO): William M. Sams

Responsibilities

- Coordinate with project managers in matters of health and safety.
- Report to CMHS on health and safety matters.

TABLE 2-1
(Continued)

-
- **Develop or review and approve project health and safety plans prior to submittal to the CMHS for review.**
 - **Conduct staff training and orientation on health and safety related activities.**
 - **Appoint or approve site safety officers.**
 - **Monitor compliance with health and safety plans and conduct site audits.**
 - **Assist project managers to obtain required health and safety equipment.**
 - **Approve personnel to work on hazardous waste management projects with regard to medical examinations and health and safety training.**

Authorities

- **Suspend work or otherwise limit exposures to personnel if health and safety plan appears to be unsuitable or inadequate.**
- **Direct personnel to change work practices if existing practices are deemed to be hazardous to health and safety of personnel.**
- **Remove personnel from projects if their actions or condition endangers their health and safety or the health and safety of coworkers.**
- **Approve restart of field activities following a temporary suspension that was based upon health and safety consideration.**

PROJECT MANAGER AND SITE MANAGER: Al Claybourn/Ken Pacheco

Responsibilities

- **Ensure that the project is performed in a manner consistent with the WC health and safety program.**
- **Provide the HSO with the project information needed to develop health and safety plans.**
- **Ensure that the project health and safety plans are prepared/approved and properly implemented in a timely manner.**

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TABLE 2-1
(Continued)

-
- Ensure that adequate funds are allocated to fully implement project health and safety plans.
 - Ensure compliance with health and safety plans of contractor personnel.
 - Coordinate with the HSO on health and safety matters.

Authorities (Safety Related)

- Assign an HSO approved SSO to project and, if necessary, assign a suitably qualified replacement.
- Temporarily suspend field activities, if health and safety of personnel are endangered, pending an evaluation and approval for resumption of work by the HSO and/or CMHS
- Temporarily suspend an individual from field activities for infractions of the health and safety plan, pending an evaluation and approval for resumption of work by the HSO, and/or CMHS.

SITE SAFETY OFFICER (SSO): Gregg Miller

The SSO will be appointed by the Project Manager with the approval of the HSO.

Responsibilities

- Direct health and safety activities onsite.
- Report immediately all safety-related incidents or accidents to the HSO and project manager.
- Assist project managers in all aspects of implementing health and safety plans.
- Maintain health and safety equipment on site.
- Implement emergency procedures as required.
- Approve personnel to work in the field on the Phase II RFI/RI for Operable Unit 2.

**TABLE 2-1
(Continued)**

Authorities

- Can temporarily suspend field activities, if health and safety of personnel are endangered, pending further consideration and approval for resumption of work by the HSO and/or CMHS.
- Can temporarily suspend an individual from field activities for infractions of the health and safety plan, pending further consideration and approval for resumption of work by the HSO and/or CMHS.

HEALTH AND SAFETY TECHNICIAN (HST): As assigned by the Site Manager

The health and safety technicians (HSTs) shall assist the SSO in implementing site Health and Safety Plans (HSP). An HST will be present (in the immediate vicinity) during all activities involving drilling, trenching, or sampling of wastes or soils. None of these activities shall be permitted in the absence of an HST.

Responsibilities

- Ensure that each individual within his/her jurisdiction complies with the provisions of the HSP.
- Provide on-site air monitoring during field activities.
- Audit safety practices used by on-site teams.
- Communicate with command post for on-site activities.
- Supervise decontamination, monitor workers for heat or cold stress, and distribute health and safety equipment.
- Document safety practices.
- Initiate appropriate emergency procedures.

Authority

The health and safety technician shall have the authority to stop work in case of an imminent safety hazard or potentially dangerous situation. After stopping work, the health and safety technicians shall immediately consult the SSO.

3.0 SITE INFORMATION

3.1 INTRODUCTION

The Rocky Flats Plant (RFP) began operations in 1952 and is part of the nationwide nuclear weapons development, production, and research complex currently administered by the Department of Energy (DOE). Primary production activities include fabrication of nuclear weapons components from beryllium, plutonium, stainless steel, and uranium; assembly of components; and chemical recovery and purification of recyclable transuranic radionuclides. The major classes of waste generated include solid waste, hazardous waste, radioactive waste, and mixed (radioactive and hazardous) waste.

Accidental releases of wastes have occurred over the years. The Environmental Protection Agency (EPA) published the final decision to add Rocky Flats to the National Priorities List in the October 4, 1989 Federal Register. Cleanup at Rocky Flats is being conducted under two major environmental laws according to an Interagency Agreement (IAG) (dated January 22, 1991) between the DOE, EPA, and CDH: (1) the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, also known as Superfund), which addresses inactive waste disposal sites at the plant; and (2) the Resource Conservation and Recovery Act (RCRA), which addresses past and active storage and disposal areas of the plant.

3.2 PHYSICAL FEATURES

RFP is located northwest of Denver in central Colorado. The Plant consists of approximately 6,550 acres of federally owned land. Major buildings are located within a plant security area of approximately 400 acres. The plant security area is surrounded by a buffer zone of approximately 6,150 acres. The entire facility is roughly bounded by State Highway 93 on the west, State Highway 128 on the north, Indiana Street on the east, and State Highway 72 on the south.

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3.3 TOPOGRAPHY

The natural environment of RFP and vicinity is influenced primarily by its proximity to the Front Range of the Rocky Mountains. The Plant is directly east of the north-south trending Rocky Mountains, with an elevation of approximately 6,000 feet above sea level. RFP is located on a broad, eastward-sloping plain of overlapping alluvial fans developed along the Front Range. The fans extend about 5 miles in an eastward direction from their origin in the abruptly rising Front Range and terminate on the east at a break in slope to rolling hills. The Continental Divide is about 16 miles west of the Plant. The Plant Security Area is located near the eastern edge of the fans on a terrace between stream-cut valleys (North Walnut Creek and Woman Creek).

3.4 HYDROLOGY

There is considerable interaction between surface water and groundwater. Surface water and groundwater flow in the unconfined system is generally from west to east.

3.5 BIOLOGY

Animal life inhabiting RFP and its buffer zone consists of species associated with Western prairie regions. The most common large mammal is the mule deer, with an estimated 100 to 125 permanent residents. There are a number of small carnivores, such as coyote, red fox, striped skunk, and long-tailed weasel. A profusion of small herbivores can be found throughout the Plant site and buffer zone, consisting of species such as the pocket gopher, white-tailed jackrabbit, and the meadow vole. Bull snakes and rattlesnakes are the most frequently observed reptiles. Eastern yellow-bellied racers have also been seen. Western plains garter snakes are found in and around many of the ponds.

3.6 HISTORY OF OPERABLE UNIT NO. 2 (OU2) AND OUTLYING AREAS

Site descriptions presented in the following sections are taken from the final Phase II RFI/RIFS Work Plan (Alluvial) Rocky Flats Plant 903 Pad, Mound and East Trenches Areas (Operable Unit 2) 12 April 1990. These descriptions are based on historical records, aerial photography review, and interviews with Plant personnel. Further characterization of each site based on other historical reports is also included in the following discussions.

For the purposes of this Health and Safety Plan, OU2 has been subdivided into four areas: the 903 Pad Area, the Mound Area, the East Trenches Areas, and Outlying Areas. The first three of these areas are further subdivided into Individual Hazardous Substance Sites IHSSs with an assigned reference number. The fourth area consists of outlying areas surrounding each IHSS.

3.6.1 903 Pad Area

Five IHSSs are located within the 903 Pad Area (Figure 3-1). These sites are:

- 903 Drum Storage Site (IHSS No. 112)
- 903 Lip Site (IHSS No. 155)
- Trench T-2 Site (IHSS No. 109)
- Reactive Metal Destruction Site (IHSS No. 140)
- Gas Detoxification Site (IHSS No. 183)

A brief history of each IHSS within the 903 Pad Area is provided in the following subsections.

3.6.1.1 903 Drum Storage Site (IHSS No. 112)

The 903 Drum Storage Site is located in the eastern portion of the Plant Security Zone. This area was used from October 1958 to January 1967 for storage of radioactively contaminated oil drums. Presented below is a description (extracted from Calkins, 1970) of drums stored at the Drum Storage Site.

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"Most of the drums transferred to the field were nominal 55-gallon drums, but a significant number were 30-gallon drums. Not all were completely full. Approximately three-fourths of the drums were plutonium-contaminated, while most of the balance contained uranium. Of those containing plutonium, most were lathe coolant consisting of a straight-chain hydrocarbon mineral oil (Shell Vitrea) and carbon tetrachloride in varying proportions. Other liquids were involved, however, including hydraulic oils, vacuum pump oil, trichloro-ethylene, perchloroethylene, silicone oils, acetone still bottoms, etc. Originally, contents of the drums were indicated on the outside, but these markings were made illegible through weathering and no other good records were kept of the contents. Leakage of the oil was recognized early, and in 1959 or possibly earlier ethanolamine was added to the oil to reduce the corrosion rate of the steel drums."

Drum leakage was noted at the 903 Drum Storage Site in 1964 during routine drum handling operations (Dow Chemical, 1971). Corrective action consisted of transferring the contents of leaking drums to new drums and fencing the area to restrict access (Dow Chemical, 1971). Approximately 420 drums leaked to some degree, and, of these, an estimated 50 leaked their entire contents (Dow Chemical, 1971). An estimated 5,000 gallons of liquid (Freiberg, 1970) containing 5.3 curies (Ci) of plutonium leaked into the soil (Dow Chemical, 1971). A heavy rainstorm in 1967 spread contaminants to a ditch south and southeast of the drum storage site (Dow Chemical, 1971).

The shipment of drums to the 903 Drum Storage Site ended in January 1967 when drum removal efforts began. Removal of all drums and wastes was completed in June 1968.

Presented below is a chronology of the 903 Drum Storage Site cleanup as described by Freiberg (1970).

- From January 23, 1967 through March 10, 1967, uranium oil drums which were in good condition were transferred to Building 774 and processed.
- Building 903 . . . on March 10, 1967, started processing oil drums. This building was designed to prefilter the oil prior to transferring plutonium contaminated oil to Building 774 for final processing.

- From March 10, 1967 through May 18, 1967, there were a total of 191 drums of plutonium contaminated oil filtered and shipped to Building 774.
- On May 18, 1967, operations at Building 903 were discontinued due to the amount of time this process was taking.
- Drum-to-drum transfer in the field began May 18, 1967, and the drums were [SIC] shipped to Building 774 without prior filtration in Building 903.
- From March 17, 1967 through May 10, 1967, in addition to the plutonium transfers, there were 297 drums of uranium contaminated Alk-Tri waste shipped to Building 774 and processed.
- May 10, 1967 through May 28, 1968, a total of 4,826 drums containing 50 gallons of oil each were sent to Building 774 and processed.
- During the transfer operations, it was noted that at the bottom of all drums a deposit of sludge remained after removal of the oil. This sludge varied in depth from ½ inch to 3 inches and averaged approximately 1 inch. By drum counter results, the sludge within the empty drums contained a total of 5, 152 grams of plutonium. These empty drums were later disposed of by adding Oil Dry and MicroCel to absorb the sludge. The drums containing the plutonium sludge and absorbent were then incased in plastic, placed in boxes, and shipped to the burial grounds." The location of the burial grounds is not provided.

There were originally a total of 5,237 drums at the drum storage site when cleanup operations began in 1967. After transfer of the contents to new drums, 4,826 drums were transported to Building 774, of which 3,572 drums contained plutonium-contaminated oil. This leaves the contents of 411 drums unaccounted for. The most probable explanation for this discrepancy is a combination of the following factors according to Freiberg (1970):

- All of the drums originally sent to the storage site were not completely full
- Some of the volume was taken up by the sludge that was discarded with the empty barrels
- Leakage out of the barrels and onto the ground occurred

Information provided by Freiberg (1970) indicates that an estimated 5,000 gallons of oil leaked from drums onto the ground at the Drum Storage Site. This estimate was based on the memory and knowledge of those involved in site operations (Freiberg, 1970).

In November 1968, site grading began at the 903 Drum Storage Site in preparation for applying an asphalt cap over the area. This work included moving "slightly" contaminated soil from around to inside the fenced area (Freiberg, 1970). A total of 33 drums of radioactively contaminated rocks were removed from the area in May 1969, and two courses of clean fill material were placed over the site during the late summer of 1969. The asphalt was applied in October 1969, and in February 1970, additional road base course material was applied to soils directly east and south of the asphalt pad due to soil contamination (Freiberg, 1970)

The asphalt containment cover is rectangular and oriented north-south (370 feet) and east-west (395 feet). The pad slopes slightly to the northeast at a drop of 1 foot per 100 feet. The asphalt cover is approximately 8 centimeters (cm) (3.2 inches) thick and it is underlain by approximately 15 cm (6 inches) of loose gravel and 8 cm of soil fill.

3.6.1.2 903 Lip Site (THSS No. 155)

During drum removal and cleanup activities associated with the 903 Drum Storage Site, winds redistributed plutonium beyond the asphalt pad (not present at that time) to the south and east. An estimated 1 Ci of plutonium was redistributed beyond the pad, and, of that 1 Ci, approximately 0.56 Ci is believed to have been deposited in the 903 Lip Site (Barker 1982). The most contaminated area was immediately adjacent to the pad to the south and southeast.

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Surveys at the time of the drum removal project and subsequent annual soil sampling from 1969 to 1972 showed a maximum plutonium concentration of 2,258 picoCuries per gram (pCi/g) in the top 5 cm (2 inches) of soil at the 903 Lip Site (Barker, 1982)

Soil cleanup efforts were undertaken in 1976, 1978, and 1984 to remove plutonium-contaminated soils from three different areas within the 903 Lip Site. The 1976 soil removal operation began in June 1976 and ended in September 1976. This cleanup consisted of hand-excavating contaminated soils from an area near the Reactive Metal Destruction Site until soil-contamination levels were below the detection limit of the Field Instrument for Detection of Low Energy Radiation (FIDLER). The detection limit of the FIDLER is 250 counts per minute (cpm) (Barker, 1982). The excavated area was covered with clean top soil and reseeded with native grasses. Thirty-five boxes, weighing a total of 125,000 pounds, were removed and shipped off site for disposal during the 1976 cleanup (Barker, 1982)

The 1976 soil-removal technique of hand-excavation was inefficient, considering the large amount of contaminated soils requiring removal at the 903 Lip Site. In June 1978, a second soil removal project began north of the 1976 removal using a front-end loader alone and with a bulldozer. All soil that exceeded 2,000 cpm, as determined by a FIDLER survey, was removed. Cleaned areas were resurveyed and soil removal continued until background readings (approximately 250 cpm by a FIDLER survey) were obtained. Topsoil was then applied to the excavated area, and the site was revegetated with native grasses. During the 1978 soil removal, 1,448 boxes, weighing approximately 4.7 million pounds, were removed and shipped off site (Barker, 1982).

Approximately 0.5 Ci of plutonium were removed from the 903 Lip Site during the two soil removal projects. This quantity is based on an average soil plutonium concentration of 545 pCi/g and a soil density of 1 gram per cubic centimeter (g/cm^3) (Barker, 1982).

A third soil cleanup was performed along the eastern edge of the 903 Lip Site in 1984. A total of 214 tri-wall pallets of contaminated soil were removed from the area. The excavated area was backfilled with clean topsoil (Setlock, 1984).

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3.6.1.3 Trench T-2 Site (IHSS No. 109)

Trench T-2 is located south of the 903 Drum Storage Site and west of the Reactive Metal Destruction Site. This trench was used before 1968 for the disposal of sanitary sewage sludge and flattened drums contaminated with uranium and plutonium. This trench is believed to measure approximately 15 feet wide by 200 feet long by 5 feet deep (Rockwell International, 1987). Barrels were noted in the western end of Trench T-2 during 1987 investigations.

3.6.1.4 Reactive Metal Destruction Site (IHSS No. 140)

The Reactive Metal Destruction Site is located on the hillside south of the 903 Drum Storage Site. This site was used during the 1950s and 1960s primarily for the destruction of lithium metal (U.S. DOE 1986). Approximately 400 to 500 pounds of metallic lithium were destroyed on the ground surface in this area and the residues, primarily nontoxic lithium carbonate, buried. Smaller unknown quantities of sodium, calcium, magnesium, solvents, and unknown liquids were also destroyed at this location (Illsley, 1978).

Based on review of historical aerial photography, the Reactive Metal Destruction Site was used from 1968 to 1971. Barrels were noted in the southwestern corner of IHSS No. 140 during 1987 investigations (U.S. DOE, 1990).

3.6.1.5 Gas Detoxification Site (IHSS No. 183)

Building 952, located south of the 903 Drum Storage Site, was used to detoxify various gases from lecture bottles between June 1982 and August 1983. The lecture bottles held approximately 1 liter of compressed gas each. The gases consisted of various types of nitrogen oxides, chlorine, hydrogen sulfide, sulfur tetrafluoride, methane, hydrogen fluoride, and ammonia that were used in Plant research and development work. Gas detoxification was accomplished by using various commercial neutralization processes available at the time. After neutralization, glassware used in the process was triple-rinsed, crushed, and deposited in the present landfill. The neutralized gases were released to the environment during detoxification.

3.6.2 Mound Area

The Mound Area is composed of four sites (Figure 3-1). These are:

- Mound Site (IHSS No. 113)
- Trench T-1 Site (IHSS No. 108)
- Oil Burn Pit No. 2 Site (IHSS No. 153)
- Pallet Burn Site (IHSS No. 154)

A brief history of each IHSS within the Mound Area is provided in the following subsections

3.6.2.1 Mound Site (IHSS No. 113)

The Mound Site, located north of Central Avenue in the eastern Plant Security Zone was used between April 1954 and September 1958 for drum disposal. Approximately 1, 405 drums primarily containing depleted uranium and beryllium-contaminated lathe coolant (a mixture of about 70 percent hydraulic oil and 30 percent carbon tetrachloride) were placed at the Mound Site (Rockwell International, 1987). Records do not indicate that the barrels were actually buried (Calkins, 1970). It is likely that some of the coolant also contained enriched uranium and plutonium (Rockwell International, 1987). Some drums also contained Perclene, a brand name of tetrachloroethene (PCE) (Sax and Lewis, 1987). Some of the drummed wastes placed in the Mound Site were in solid form (Rockwell International, 1987).

Cleanup of the Mound Site was accomplished in May 1970, and the materials removed were packaged and shipped to an off-site DOE facility for disposal. Listed below is an inventory of the 1,405 drums removed from the Mound Site in 1970 (Dow Chemical 1971).

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<u>No. of Drums</u>	<u>Contents</u>
903	30-gallon drums of depleted uranium solid waste
21	30-gallon drums of depleted uranium oil waste
12	30-gallon drums of plutonium-contaminated oil waste. "The plutonium content was so low that it was measurable only by the most sensitive laboratory techniques."
102	55-gallon drums of depleted uranium solid waste
282	55-gallon drums of depleted uranium oil waste
<u>85</u>	55-gallon drums of enriched uranium oil waste
1,405	TOTAL DRUMS

Subsequent surficial soil sampling in the vicinity of the excavated Mound Site indicated 0.4 to 51 pCi/g activity. This radioactive contamination is thought to have come from the 903 Drum Storage Site via wind dispersion rather than from drums previously stored at the Mound Site as it was limited to the surface (Rockwell International, 1987).

3.6.2.2 Trench T-1 Site (IHSS No. 108)

The trench was used from 1954 until 1962 and contains approximately 125 drums filled with approximately 25,000 kilograms (kg) (55,115 pounds) of depleted-uranium chips (Dow Chemical, 1971) and plutonium chips coated with a small amount of lathe coolant (Rockwell International, 1987). The estimated dimensions of Trench T-1 are 15 feet wide by 200 feet long by 5 feet deep. Trench T-1 was covered with about 2 feet of soil, and the corners have been marked.

Weed-cutting activities in October and November 1968 unearthed two drums inadequately covered with fill material. Both drums were sampled and analyzed for total plutonium and uranium content before they were disposed off site (Illsey, 1983). The off-site disposal location is not known. One of the drums sampled contained an oil-water mixture with 55 pCi/l of

plutonium and 2.3×10^5 pCi/g of uranium. The other drum contained an oily sludge with 4.6 pCi/g of plutonium and 1.2×10^6 pCi/g uranium (Illsley, 1983).

3.6.2.3 Oil Burn Pit No. 2 (IHSS No. 153)

Oil Burn Pit No. 2 is actually two parallel trenches that were used in 1957 and from 1961 to 1965 to burn approximately 1,082 drums of oil-containing uranium (Rockwell International, 1987). In March and April of 1957, the contents of an estimated 169 uranium contaminated waste oil drums were burned. No further burning took place until 1961. Frequent burning of waste oil took place from June 1961 to May 1965. The contents of approximately 914 drums were burned during this time. The drums used for the oil burning operations were generally reused, however, 300 empty drums were discarded by flattening and burying them in the burning pits (Dow Chemical, 1971). The uranium concentrations of the burned waste oil is unknown. The residues from the burning operations and the flattened drums were covered with backfill. In 1978, the area was excavated to a depth of approximately 5 feet and 239 boxes (56 cubic feet per box) of contaminated soil were removed and shipped off site to an authorized DOE disposal site (Illsley, 1983). The off-site disposal location was not known.

3.6.2.4 Pallet Burn Site (IHSS No. 154)

An area southwest of Oil Burn Pit No. 2 was reportedly used to destroy wooden pallets in 1965. The types of hazardous substances or radionuclides that may have been spilled on these pallets is unknown. This site was cleaned up and reclaimed in the 1970s (U.S. DOE, 1986).

3.6.3 East Trenches Area

The East Trenches Area consists of nine burial trenches and two spray irrigation sites. A brief history of these IHSSs is provided in the following subsections.

- Trench T-3 (IHSS No. 110)
- Trench T-4 (IHSS No. 111.1)

- Trench T-5 (IHSS No. 111.2)
- Trench T-6 (IHSS No. 111.3)
- Trench T-7 (IHSS No. 111.4)
- Trench T-8 (IHSS No. 111.5)
- Trench T-9 (IHSS No. 111.6)
- Trench T-10 (IHSS No. 111.7)
- Trench T-11 (IHSS No. 111.8)
- East Spray Irrigation Sites (IHSS Nos. 216.2 and 216.3)

3.6.3.1 Trenches T-3 through T-11 (IHSS Nos. 110 and 111.1-111.8)

Trenches T-3, T-4, T-10, and T-11 are located north of the east access road, and Trenches T-5 through T-9 are south of the east access road. The wastes in these trenches have not been disturbed since their burial. These trenches, as well as Trench T-2 discussed earlier, were used from 1954 to 1968 for disposal of approximately 125,000 kg of sanitary sewage sludge contaminated with uranium and plutonium and approximately 300 flattened empty drums contaminated with uranium (Illsley, 1983). Radiation content of the sewage sludge ranged from 382 pCi/g to 3,590 pCi/g (Owen and Steward, 1973). Trenches T-4 and T-11 also contain some plutonium- and uranium-contaminated asphalt planking from the solar evaporation ponds (Illsley, 1983).

According to Illsley (1983), soil samples have been collected from Trenches T-9, T-10, and T-11, and the results were as follows:

"Samples from T-11 contained plutonium in the range from 4.5 to 50 pCi/g and uranium-238 in the range between 0.9 and 158 pCi/g. Trench T-10 was found to contain uranium in the range between 40 and 126 pCi/g and Pu-239 in the range from 0.18 to 14 pCi/g Plutonium concentrations in collected samples varied from 0.40 to 68 pCi/g and uranium was found in the range between 2.4 and 450 pCi/g in Trench T-9 "

The sampling dates and collection methods of these samples are unknown.

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3.6.3.2 East Spray Irrigation Sites (IHSS Nos. 216.2 and 216.3)

IHSSs 216.2 and 216.3 were used for spray irrigation of sewage treatment plant effluent. These areas have been designated as IHSSs because effluent containing low concentrations of chromium was inadvertently sprayed in the area in February and March 1989. The chromium entered the sanitary sewage treatment plant on February 23, 1989 subsequent to a spill of chromic acid in Building 444 (Rockwell International, 1989)

3.6.4 Outlying Areas

The Outlying Areas are defined as those areas that are not within the boundaries of an IHSS but that surround any given IHSS. There is a potential for contaminant plumes being present in Outlying Areas.

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4.0 WORK ACTIVITIES

This Health and Safety Plan covers activities associated with the Phase II RFI/RI for Operable Unit 2. The required sampling and investigative activities are described in the Phase II Work Plans for alluvial and bedrock components of the RFI/RI and in the Rocky Flats Environmental Restoration Program Standard Operating Procedures (SOPs). The planned start date is May 1991 and the activities are expected to take 12 to 18 months to complete. The specific activities covered by this plan follow:

- Surveying and staking borehole and monitoring well locations
- Nonintrusive geophysics
- Well drilling and construction (approximately 150 to 200 wells)
- Borehole drilling (approximately 60 to 80 boreholes)
- Shallow (less than 1 inch deep) surface soil samples at approximately 1,500 locations
- Trenching to allow for sampling of soil from the sides of shallow (approximately 3 feet deep) trenches at approximately 24 locations
- Packer testing
- Personnel decontamination
- Equipment decontamination
- Core logging
- Operating a main decontamination facility

5.1 OVERVIEW

A review of Rocky Flats Plant history and previous studies of the regional animal life, climate, and the general industry-wide experience with using heavy equipment, indicates that there are several sources of potential hazards to be assessed. The potential hazards have been placed into one of five classifications listed below:

- Encounters with native wildlife (See Attachment A for a narrative concerning the types of wildlife found at Rocky Flats Plant and the associated diseases)
- Climatic conditions such as temperature extremes, thunder storms (lightning) and high winds
- Working around light and heavy equipment
- Radioisotopes in the soils and groundwater (Attachment B provides basic information regarding characteristics of the radioisotopes likely to be encountered)
- Nonradioactive potentially hazardous chemicals in soils and groundwaters (Attachment C contains Material Safety Data Sheets (MSDSs) for nonradioactive potentially hazardous chemicals known to exist on site)

5.2 METHODOLOGIES USED TO COMPLETE THE HAZARD ASSESSMENTS

The following is a brief summary of how hazard assessments were accomplished. Detailed information regarding how hazard assessments were accomplished is presented in various attachments as specified in the text below. A summary of results from the hazard assessment process is given in Subsection 5.3.

5.2.1 Methodology Employed to Assess Wildlife, Environmental Extremes, and Working With Equipment

There is a certain likelihood for each of the potential hazard classifications listed in Subsection 5.1 above to become a true hazard. But we have not attempted to estimate the likelihood of such occurrences for all classifications of potential hazards. Our assessment of the first three classifications of potential hazards (encounters with native wildlife, environmental extremes, and working with equipment) is subjective and indicates that they will exist at each work site, and, therefore, that steps must be taken to minimize the hazard (see Section 6.0, General Health and Safety Requirements; Section 7.0, Site-Specific Health and Safety Requirements, and various standard operating procedures (SOPs) contained in Attachment D).

5.2.2 Methodology Employed to Assess Radioisotopes and Nonradioactive Potentially Hazardous Chemical Exposures

Our assessments of the last two classifications of potential hazards (radioisotopes in the soils and groundwater and nonradioactive potentially hazardous chemicals in soils and groundwaters) are presented by discussing the three potential routes of exposure. The routes of exposure discussed are absorption and injection (through the skin), ingestion, and inhalation.

5.2.2.1 The Absorption, Injection, and Ingestion Routes Of Exposure

A subjective manner of evaluation was used to assess the first three routes of exposure. Our assessment indicates that these three routes of exposure will exist at each work site, and, therefore, that steps must be taken to minimize exposures by these routes. Methods of decreasing the likelihood of an exposure occurring via these routes are provided in Section 6.0, General Health and Safety Requirements; Section 7.0, Site-Specific Health and Safety Requirements; and various standard operating procedures (SOPs) contained in Attachment D.

5.2.2.2 The Inhalation Route of Exposure

Mathematical modeling was used to estimate maximum airborne concentrations and thereby assess the potential for inhalation hazards to exist (see Attachment E, Estimating Airborne Concentrations of Radioisotopes From Soils; and Attachment F, Estimating Airborne Concentrations of Volatile and Semivolatile Organic Compounds In Groundwater) Estimates of airborne concentrations of radioisotopes assume the airborne dust concentration to be 450 $\mu\text{g}/\text{m}^3$

No attempt has been made to estimate airborne concentrations of organic compounds, metals, pesticides, or PCBs from soils for the following reasons

- There is no prescribed method for estimating airborne concentrations of organic compounds from soils likely to be emitted up through a hollow-stem auger. However, it is accepted practice industry wide to accomplish organic vapor measurements at each site of intrusive activity to monitor for the airborne concentration of organics and we will accomplish those measurements.
- The levels of metals, pesticides and PCBs found during Phase I RI are generally so low as not to be a potential inhalation hazard for occupational exposures.

With two exceptions, the maximum estimated airborne concentrations are below the level requiring classification as a potential inhalation hazard. The maximum estimated airborne concentration of plutonium-239 (Pu-239) at the 903 Pad (IHSS No. 112) is sufficient to indicate classification as an inhalation hazard is appropriate (see Subsection 5.3.2.1). The maximum estimated airborne concentration of vinyl chloride from groundwater in the Outlying Area north of the Mound Area is sufficient to indicate classification as a potential inhalation hazard is appropriate (see Subsection 5.3.2.21).

5.2.3 Classification of Maximum Expected Airborne Concentrations

The following terminology and criteria have been adopted for use in this Health and Safety Plan when discussing the results of calculations to determine the airborne concentration of a potential contaminant:

- **Derived Air Concentration (DAC)** For the purposes of this health and safety plan a DAC is an upper limit established by the Department of Energy (DOE) in DOE Order 5480 11, Radiation Protection for Occupational Workers, dated December 21, 1988. However, it is the policy of both DOE and W-C to maintain personnel exposures to ionizing radiation as low as reasonably achievable. Exposures above the DAC may increase the potential for occurrence of genetic effects, carcinogenic effects, and/or other health effects.
- **Permissible Exposure Limit (PEL)** For the purposes of this health and safety plan a PEL is an upper limit established by OSHA or another nationally recognized body in lieu of an existing OSHA standard for occupational exposures to nonradioactive airborne substances. Exposures above the PEL may increase the potential for ill effects. The potential ill effect is dependent upon the specific substance involved.
- **No Potential Inhalation Hazard:** The maximum estimated airborne concentration of a radioisotope is less than 1/10th the applicable DAC or the maximum estimated vapor concentration of a substance is less than 1/2 the PEL.
- **Potential Inhalation Hazard:** The maximum estimated airborne concentration of a radioisotope is equal to or greater than 1/10th the applicable DAC or the maximum estimated vapor concentration of a substance is equal to or greater than 1/2 the PEL. In any case, the maximum airborne concentration must be less than the applicable DAC or PEL.

- **Inhalation Hazard:** The estimated airborne concentration of a radioisotope is equal to or greater than the applicable DAC or PEL.

5.3 HAZARD ASSESSMENTS FOR EACH IHSS SITE AND OUTLYING AREAS

The following subsections contain our assessments of the hazards in a worst-case scenario when working at each IHSS and Outlying Area. Hazard assessments for maintenance activities associated with a main decontamination facility and during core logging are provided in Section 5.4. These assessments do not consider the effects of implementing the practices and required exposure controls described in Section 6.0, General Health and Safety Practices, or in Section 7.0, Site-Specific Health and Safety Requirements.

5.3.1 Wildlife, Climatic Conditions, and Working With Equipment

Although not specified under each IHSS, our assessment indicates the following potential hazards will exist at each field work site.

Potential hazards considered to be a plausible source of harm at each site include encounters with wildlife and their associated diseases, climatic conditions such as temperature extremes, thunder storms (lightning) and high winds, and working around light and heavy equipment.

5.3.2 Radioisotopes and Nonradioactive Potentially Hazardous Chemicals

The absorption, injection, and ingestion routes of entry are considered to be a source of potentially hazardous exposures to radioisotopes and nonradioactive hazardous chemicals at each site.

The inhalation route of exposure for each IHSS is discussed in the following subsections. The worst-case maximum airborne concentrations of radioisotopes known to exist in each IHSS are shown in Attachment E, Estimating Airborne Concentrations of Radioisotopes From Soils and Summarized in Table 5-1. The worst-case maximum airborne concentrations of organics known

TABLE 5-1
 Estimated Airborne Concentrations and Potential
 Hazard of Radioisotopes From Soils

IISS NO / NAME	ISOTOPES FOUND	SOIL ACTIVITY USED IN CALCULATIONS (pCi/g)	ESTIMATED AIRBORNE ACTIVITY (pCi/M ³)	DAC (pCi/M ³)	HAZARD ASSESSMENT
112/903 Pad	Pu-239	20,344	9.2	6	HH
	Am-241	2,270	1.62	2	PHH
155/903 Pad Lap Site	Pu-239	190	0.0055	6	NPHH
	Am-241	0.25	0.00011	2	NPHH
	U-233 & U-234	0.87	0.00009	20	NPHH
	U-238	0.81	0.00006	20	NPHH
	Sr-90	1.6	0.00072	60,000	NPHH
	Sr-90	1.6	0.00072	2,000	NPHH
108-111.8/T 1 through T 11 (all trenches)**	Pu-239	68	0.0006	6	NPHH
	U-238	430	0.202	20	NPHH
140/Reactive Metals Destruction Site	Pu-239	100	0.045	6	NPHH
	Am-241	13	0.0009	2	NPHH
	U-233 & U-234	3.3	0.0015	20	NPHH
	U-238	2.2	0.00099	20	NPHH
	Sr-90	1.6	0.00072	60,000	NPHH
	Sr-90	1.6	0.00072	2,000	NPHH
113/Mound Site	***	51	0.020	3	NPHH
216.2 & 216.3/East Spray Field (Center & South Areas And Outlying Areas)	Pu-239	11.34	0.005	7	NPHH
181/Gas Detoxification Site	****				NPHH
153/Oil Burn Pa	****				NPHH
154/Pallet Burn Pa	****				NPHH

* Definitions (see Subsection 5.2.3) PHH Potential Inhalation Hazard NPHH - No Potential Inhalation Hazard HH - Inhalation Hazard

The amount of radioactivity/gram of soil has not been determined within all trenches. Although the radioactivity/gram has been determined in three trenches with the highest activities found in Trench T-9 (IISS 111.6) and those values have been assigned to all Trenches for the purposes of our hazard assessment.

A review of the site history indicates a soil activity of 51 pCi/g of an unspecified radioisotope has been noted. We have calculated the maximum expected airborne activity and compared it to the most restrictive DAC (Ann-211) for the isotopes found at Rocky Flats Plant.

A review of the history of this IISS does not indicate radioisotopes were disposed of here.

to exist in groundwaters are shown in Attachment F, Estimating Airborne Concentrations of Organics in Groundwaters

5.3.2.1 903 Drum Storage Site (IHSS No. 112)

The maximum estimated airborne concentrations of Pu-239 (DAC=6 pCi/m³) and Americium-241 (Am-241) (DAC = 2 pCi/m³) that could be generated by disturbing soils beneath the asphalt pad indicates that classification as an inhalation hazard is appropriate. Although analysis of air samples collected east of the 903 Pad during 1964 through 1970 indicated that the maximum monthly average of daily sampling events was 0.25 pCi of total activity. And, at no time did values from the air samplers indicate that permissible levels of plutonium contamination in air had been exceeded. These analysis results are noteworthy because they represent conditions as the original contaminated soil surface was being graded in preparation for construction of the asphalt pad present today. Nonetheless, we consider airborne radioisotopes to be an inhalation hazard.

The maximum estimated airborne concentration of trichloroethene (TCE) and tetrachloroethene (PCE) that could be generated by disturbing groundwater beneath the asphalt pad does not indicate that classification as a potential inhalation hazard is appropriate.

5.3.2.2 903 Lip Site (IHSS No. 155)

The maximum estimated airborne concentrations of radioisotopes that could be generated by disturbing soils does not indicate that classification as a potential inhalation hazard is appropriate. The following radioisotopes are known to be present and were considered in this assessment: Pu-239; Am-241; uranium-233 (U-233), uranium-234 (U-234), and uranium-238 (U-238), strontium-89 (Sr-89) and strontium-90 (Sr-90).

The maximum estimated airborne concentration of nonradioactive potentially hazardous substances that could be generated by disturbing groundwater does not indicate that classification as a potential inhalation hazard is appropriate. TCE and PCE nonradioactive

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potentially hazardous substances known to be present in groundwater and were considered in this assessment.

5.3.2.3 Reactive Metals Destruction Site (IHSS No. 140)

The maximum estimated airborne concentrations of radioisotopes that could be generated by disturbing soils does not indicate that classification as a potential inhalation hazard is appropriate. The following radioisotopes are known to be present and were considered in this assessment: Pu-239, Am-241, U-233, U-234, and U-238, Sr-89 and Sr-90.

The maximum estimated airborne concentration of nonradioactive potentially hazardous substances that could be generated by disturbing groundwater does not indicate that classification as a potential inhalation hazard is appropriate. The following nonradioactive potentially hazardous substances are known to be present in groundwater and were considered in this assessment: TCE, PCE, and CCl₄.

5.3.2.4 Gas Detoxification Site (IHSS No. 183)

Radionuclides are not considered to be a potential inhalation hazard in this IHSS area based upon a review of the site history and soil sampling results from the area.

The maximum estimated airborne concentration of nonradioactive potentially hazardous substances that could be generated by disturbing groundwater does not indicate that classification as a potential inhalation hazard is appropriate. The following nonradioactive potentially hazardous substances are known to be present in groundwater and were considered in this assessment: TCE, PCE, and CCl₄.

5.3.2.5 Mound Site (IHSS No. 113)

The maximum estimated airborne concentrations of radioisotopes that could be generated by disturbing soils does not indicate that classification as a potential inhalation hazard is

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appropriate. Any of the following radioisotopes may be present Pu-239, Am-241, U-233, U-234, and U-238, Sr-89 and Sr-90. The phrase "may be present" is used because although a soil activity of 51 pCi/gm has been reported, the isotope was not identified. Results of calculations to determine the maximum airborne concentration were compared to the most restrictive DAC for the isotopes that may be present (Am-241)

The maximum estimated airborne concentration of nonradioactive potentially hazardous substances that could be generated by disturbing groundwater does not indicate that classification as a potential inhalation hazard is appropriate. The following nonradioactive potentially hazardous substances are known to be present in groundwater and were considered in this assessment: TCE and PCE.

5.3.2.6 Oil Burn Pit No. 2 (IHSS No. 153)

Radionuclides are not considered to be a potential inhalation hazard in this IHSS area based upon a review of the site history and soil sampling results from the area.

The maximum estimated airborne concentration of nonradioactive potentially hazardous substances that could be generated by disturbing groundwater does not indicate that classification as a potential inhalation hazard is appropriate. The following nonradioactive potentially hazardous substances are known to be present in groundwater and were considered in this assessment: TCE and PCE.

5.3.2.7 Pallet Burn Pit (IHSS No. 154)

Radionuclides are not considered to be a potential inhalation hazard in this IHSS area based upon a review of the site history and soil sampling results from the area.

Airborne concentrations of nonradioactive potentially hazardous substances generated from groundwater are not anticipated in this IHSS area based upon a review of the site history and groundwater sampling results from the area.

5.3.2.8 Trenches T-1 Through T-11 (IHSSs Nos. 108 Through 111.8)

Although not all of the Trenches have been sampled to determine if radioactivity is present, Trench T-9 was found to have the highest soil activity of the trenches that have been sampled

And in the interest of being conservative, the soil activity found in Trench T-9 was used to assess the potential hazard for working at all trenches within OU2

The maximum estimated airborne concentrations of radioisotopes that could be generated by disturbing soils does not indicate that classification as a potential inhalation hazard is appropriate. The following radioisotopes are known to be present and were considered in this assessment Pu-239 and U-238

The maximum estimated airborne concentration of nonradioactive potentially hazardous substances that could be generated by disturbing groundwater does not indicate classification as a potential inhalation hazard is appropriate. The following nonradioactive potentially hazardous substances are known to be present in groundwater and were considered in this assessment: TCE and CCL₄

5.3.2.9 East Spray Field, Center Area (IHSS No. 216.2)

Radionuclides are not considered to be a potential inhalation hazard in this IHSS area based upon a review of the site history and soil sampling results from the area

Airborne concentrations of nonradioactive potentially hazardous substances generated by disturbing groundwater are not anticipated in this IHSS area based upon a review of the site history and groundwater sampling results from the area

5.3.2.10 East Spray Field, South Area (IHSS No. 216.3)

Radionuclides are not considered to be a potential inhalation hazard in this IHSS area based upon a review of the site history and soil sampling results from the area

Airborne concentrations of nonradioactive potentially hazardous substances generated from ground water are not anticipated in this IHSS area based upon a review of the site history and ground water sampling results from the area.

5.3.2.11 Outlying Areas (Non-IHSS Sites Within OU2)

Radionuclides are not considered to be a potential inhalation hazard in Outlying Areas based upon a review of the site history and soil sampling results from the area

With one exception, potentially hazardous airborne concentrations of nonradioactive hazardous substances generated by disturbing groundwater are not anticipated in this area based upon a review of the site history and groundwater sampling results from the area. The one exception is the Outlying Area north of the Mound Area. The maximum estimated airborne concentration of vinyl chloride from groundwater indicates that classification as a potential inhalation hazard is warranted.

5.4 HAZARD ASSESSMENTS FOR MAINTENANCE ACTIVITIES ASSOCIATED WITH A MAIN DECONTAMINATION FACILITY AND CORE LOGGING ACTIVITIES

The following subsections contain our assessments of the hazards in a worst-case scenario when conducting maintenance activities at a main decontamination facility and during core logging activities. These assessments do not consider the effects of implementing the practices and required exposure controls described in Section 6 0, General Health and Safety Practices, or in Section 7 0, Site-Specific Health and Safety Practices

5.4.1 Wildlife, Climatic Conditions, and Working With Equipment

Our assessment of these potential hazards is that they will exist at the MDF and during core logging operations conducted in the field

5.4.2 Radioisotopes and Nonradioactive Potentially Hazardous Chemicals

The absorption, injection, inhalation, and ingestion routes of entry are considered to be a source of potentially hazardous exposures to radioisotopes and nonradioactive hazardous chemicals at the MDF and during core logging operations

GENERAL HEALTH AND SAFETY REQUIREMENTS

6.1 MEDICAL SURVEILLANCE

All W-C field staff shall be active participants in the W-C medical surveillance program or its equivalent. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably an occupational physician. The examination shall include the tests, procedures, and frequencies described in Attachment G. And, although not specified in Attachment G, the examination will include a baseline and ext bioassay sample for radioisotopic analyses.

Radiation dosimeters will be furnished by RFP and are required for all field workers

6.2 SAFETY TRAINING

Employees shall not participate in field activities until they have been trained to a level required by their job function and responsibility. Trainers shall have received a level of training higher than and including the subject matter of the level of instruction they are providing. All training and field experience shall be certified. Training requirements are discussed below.

6.2.1 Forty-Hour Basic Training

All field employees must have completed the 40-hour basic health and safety training required under 29 CFR 1910.120 and receive 8-hour annual refresher training thereafter.

6.2.2 Three-Day On-Site Supervision

All field employees shall be required to receive a minimum of 3 days of on-site training under the supervision of a trained and experienced supervisor. On-site time under supervision shall be documented.

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6.2.3 On-Site Supervisor Training

The on-site supervisor (site manager) must have completed the basic 40-hour training course, 3 days of on-site training, first aid training, and at least 8 hours of specialized training on managing hazardous waste operations. The 8 hours of specialized training shall include instruction covering the WC health and safety program, employee training program, personal protective equipment program, spill containment procedures, and health hazard monitoring procedures and techniques.

6.2.4 Site Safety Officer (SSO) Training

The Site Safety Officer must have completed the 40-hour training, 3-day on-site supervision, and first aid training.

6.2.5 Site-Specific Safety Orientation Meeting

A site-specific safety orientation meeting shall be conducted for all project field staff, including subcontractors, prior to commencement of field activities. The following topics will be discussed at this meeting:

- Names of health and safety personnel and alternates responsible for site health and safety
- Health and safety organization
- Hazards at the site
- Exposure risk
- Personal protective equipment to be used
- Personnel and equipment decontamination procedures
- Air monitoring
- Emergency procedures

All field personnel must be provided with and read a copy of this Health and Safety Plan. At the end of the meeting, attendees should be informally quizzed to assess their understanding of the health and safety requirements, and should sign a safety compliance agreement form stating that they have read, understand, and agree to comply with the provisions of the plan. Anyone refusing to sign the form will be prohibited from working at the site.

If a new employee who has not gone through the site-specific safety orientation meeting is assigned to the site, the SSO must present a similar briefing to the new employee before he or she participates in any field activities. All new employees must sign the safety compliance agreement form before beginning fieldwork at RFP

6.2.6 EG&G Radiation Safety Training

All field employees shall be required to receive a 1-day EG&G sponsored radiation worker safety course. This course is mandatory, and the SSO will schedule attendees.

6.3 ACCIDENT/INCIDENT REPORTING

6.3.1 Woodward-Clyde (W-C)/Woodward-Clyde Federal Services (WCFS) Procedures

In the event of an accident or incident, the SSO will immediately notify the W-C Project Manager, HSO, and CMHS. Types of accidents or incidents that are considered reportable are:

- Illness resulting from chemical exposure or unknown causes
- Physical injury, including an injury that does not require medical attention
- Fire, explosions, and flashes resulting from activities performed by W-C and its subcontractors
- Infractions of safety rules and requirements
- Unexpected chemical/radiological exposures
- Occurrence involving damage to equipment and/or threat of injury

Work will be suspended to correct the cause of the accident/incident and to modify this plan as necessary.

A W-C accident/incident report form (Attachment H) must be submitted to the PM and CMHS within 24 hours of occurrence.

6.3.2 Rocky Flats Plant Procedures

The Site Safety Officer will notify the W-C PM, the RFP Environmental Restoration (ER) Program Field Supervisor, the RFP ER Program Manager, and the RFP Area Health and Safety Engineer of any accidents or incidents that occur during field activities. The Site Safety Officer will also submit a completed DOE Form Fm 5484.X to the RFP Area Health and Safety Engineer for any of the following incidents:

1. "Recordable" occupational injuries or illnesses as defined below:

OCCUPATIONAL INJURY is any injury, such as a cut, fracture, sprain, or amputation, that results from a work accident or from an exposure involving a single incident in the work environment. NOTE: Conditions resulting from animal or insect bites, or one-time exposure to chemicals are considered to be injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

2. **PROPERTY DAMAGE LOSSES** of \$1,000 or more are reported as follows: accidents that cause damage to Department of Energy (DOE) property, regardless of fault, or accident wherein DOE may be liable for damage to a second party are reportable if damage is \$1,000 or more. Include damage to facilities, inventories,

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equipment, and properly parked motor vehicles. Exclude damage resulting from a DOE reportable vehicle accident.

3. ALL MOTOR VEHICLE ACCIDENTS will be reported.

6.4 VISITOR CLEARANCES

All visitors to the site must be cleared by RFP personnel.

6.5 BUDDY SYSTEM

The "buddy system" will be used during all field activities and during maintenance activities at the main decontamination facility. At no time will an individual conduct surveying, nonintrusive geophysics, drilling, soil scraping, or trenching alone. Core logging activities do not require the use of the "buddy system."

6.6 HEALTH AND SAFETY LOGBOOK

A separate health and safety logbook and sign-in/sign-out log shall be maintained by the SSO throughout the project and turned in to the HSO after the project is completed. Logged information shall include: (1) names of all W-C and subcontract personnel entering and leaving the site each day, (2) daily listing of data collection site numbers to be visited by field teams, (3) description of unforeseen hazards and steps taken to mitigate hazards, (4) summary of telephone conversations regarding health and safety, (5) safety infractions, if any, (6) accidents and injuries, and (7) all other significant health and safety items.

6.7 WORK ZONES

Three work zones will be established around each intrusive activity: the exclusion zone, the contamination reduction zone (CRZ), and the support zone.

6.7.1 Exclusion Zone

The exclusion zone for intrusive activities (such as collecting soil samples and soil boring) is the area where contaminants could or do occur and will normally encompass a 30 foot radius around the point of intrusive activities. The boundary of the exclusion zone will be marked with either pin flags or caution tape. Personal and equipment decontamination is required when exiting an exclusion zone at an intrusive activity. All individuals entering this area must be approved by the SSO.

With one exception, an exclusion zone will not normally be established around nonintrusive activities (such as surveying and nonintrusive geophysics) and personal/equipment decontamination will not normally be accomplished. Nonintrusive activities being conducted inside IHSS No. 155, the 903 Lip Site will require personal and equipment decontamination. And, the boundary of IHSS No. 155 will serve as the exclusion zone boundary where decontamination will take place.

Certain Level B work locations requiring the use of airline respirators may have significant and widespread surface contamination, making the exclusion zone so large that the allowable distances for use with air line respirators precludes location of the breathing air source in a contamination reduction zone. Work within such a Level B exclusion zone will require the following procedures:

The air supply (cascade type) trailer for operations may be brought onto the 903 Pad Drum Storage Site because of limitations on the length of air line allowed for supplied-air operations. The air supply trailer will be brought in from the upwind direction. The air supply technician may be allowed to use Level C respiratory protection when the air supply trailer is upwind of the work site. The air supply trailer shall then be decontaminated upon removal from the work site.

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6.7.2 Contamination Reduction Zone (CRZ)

In general, the CRZ is established immediately outside the exclusion zone to minimize the migration of contaminants from the exclusion zone to clean or support areas and to reduce the exposure potential of individuals leaving the exclusion zone. Specific personnel and equipment decontamination procedures are outlined in Attachment D. The CRZ for activities conducted within the boundaries of the 903 Lip Site (IHSS No. 155) will be established immediately outside of the boundaries of the 903 Lip Site

6.7.3 Support Zone

The support zone is located in a clean area, preferably upwind and immediately outside of the CRZ, or in the on-site vehicles. Supplies, emergency equipment, and support personnel are located in the support zone or in the on-site vehicles.

6.8 FIELD ACTIVITIES

6.8.1 Personal Requirements/Prohibitions

- No running or horseplay.
- The required level of personal protective equipment must be worn by all on-site personnel.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the exclusion zone and the CRZ. Drinking of water, Gatorade, or equivalent fluids may occur in the CRZ at the discretion of the SSO.
- Smoking, carrying lighters and/or matches is prohibited in the exclusion zone and the contamination reduction zone.

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- No contact lenses may be worn by personnel engaged in field work.
- No jewelry may be worn by personnel engaged in field work, except for watches, which will be disposed of if they become contaminated.
- No facial hair which interferes with a satisfactory fit of the mask-to-face seal is allowed on personnel required to wear respirators or SCBAs.
- Medicine and alcohol can potentiate the effects from exposure to toxic chemicals. PRESCRIBED DRUGS SHOULD NOT BE TAKEN BY PERSONNEL ON OPERATIONS WHERE THE POTENTIAL FOR ABSORPTION, INHALATION, OR INGESTION OF TOXIC SUBSTANCES EXISTS, UNLESS SPECIFICALLY APPROVED BY A QUALIFIED PHYSICIAN. Alcoholic beverage intake will not be allowed during breaks.
- The entire body should be thoroughly washed in the decontamination trailer after completing decontamination procedures.
- NO PERSON WILL ENTER THE EXCLUSION ZONE ALONE.
- Safety devices on equipment must be left intact and used as designed.
- Equipment and tools will be kept clean and in good repair, and used only for their intended purpose.
- A large-faced mallet will be used for driving wood stakes; small-faced hammers, such as a claw hammer, may not be used for driving wood stakes.
- Eye protection must be worn when any hammering or pounding that may produce flying particles or slivers is performed.

- Leather gloves must be worn when handling objects that may produce slivers (e.g., driving wood stakes).

6.8.2 Contamination/Exposure Prevention

Ways in which on-site personnel may become contaminated include the following;

- Being splashed by contaminated liquids while sampling or handling liquids
- Coming in contact with contamination solids or liquids
- Walking through contamination materials, either in solid or liquid state
- Being in contact with contaminated equipment
- Being in contact with contaminated solid substances in waste piles or on the soil surface
- Sitting or kneeling on the ground

On-site team members will avoid becoming contaminated.

On-site personnel will avoid exposure to hazardous chemicals by strictly adhering to the required personal protection equipment and decontamination procedures.

Care will be taken to prevent equipment contamination. Sampling and monitoring equipment will not be laid on contaminated surfaces. Monitoring equipment and communication equipment will be bagged, and the bag taped and secured around the instrument. Openings will be made in the bag for sample intake and exhaust ports.

Procedures for limiting the particulates suspended in air are contained in Attachment J.

6.8.3 Heavy Materials Handling Safety

Below are guidelines to follow when working with heavy materials:

- Be aware of footing at all times.

- Use chains, hoists, straps, and any other equipment to safely aid in the moving or lifting of heavy objects/materials.
- Use your legs, not your back.
- Get help whenever in doubt about a material's weight.
- Use the buddy system.

6.8.4 Safety Precautions When Drilling and/or Using Heavy Equipment

All personnel engaged in drilling operations shall wear eye protection, hard hats, steel-toed boots, and hearing and respiratory protection (if required). Because tools and heavy equipment can create major hazards at sites, the following procedures are to be observed during soil-boring activities. See W-C Operating Procedure No , HS-509, Safety Guidelines for Drilling Into Soil and Rocks, provided in Attachment D.

- Use common sense.
- Hard hats and steel-toed boots are to be worn.
- Pay attention at all times.
- Maintain visual contact with Health and Safety Technician at all times when working within the exclusion zone.
- Establish hand signal communication when verbal communication is difficult. Determine one person per work group to give hand signals to equipment operators.
- All heavy equipment shall have backup alarms as specified by 29 CFR 1926.601.
- Only qualified persons are to operate heavy equipment.
- Never walk directly in back of or to the side of heavy equipment without the operator's knowledge.
- Never use a piece of equipment unless you are familiar with the operation.
- Hearing protection will be provided if work site levels exceed the levels specified by OSHA, or if requested by an employee. The rule of thumb (and W-C policy) is that if you have to shout to be heard over equipment noise, protection shall be used.
- Be sure that any underground or overhead power lines, sewer lines, gas lines, and telephone lines have been identified and will not present a hazard in the work area.

- Check that air bottles are secured properly to heavy mobile equipment.
- Mechanical equipment will be inspected daily.
- Hard hats are required when working near the drilling rig.
- Goggles or safety glasses will be worn when operating power tools, sanding, grinding, or filing. Welders' glasses or mask will be worn near welding operations.
- No loose-fitting clothing, jewelry, or free long hair is permitted near the rig.
- Hands must be kept away from the moving parts of the machinery when drilling is in progress.
- Daily inspection of all ropes, cables, and moving parts of the rig is mandatory.
- A sealed first aid kit and fire extinguisher will be available within the exclusion zone.
- Self-contained breathing apparatus units will be identified so they can be obtained, if needed, for emergency use at well or boring sites. The Site Manager will locate this equipment before drilling.
- All crews will have at least two persons, and, in addition, a Health and Safety Technician will be stationed on site to monitor activities.
- No drilling will occur during impending electrical storms or when rain or icing conditions create a work hazard.

6.8.5 Housekeeping

Housekeeping is an important aspect of an investigation program and will be strongly stressed in all aspects of field work. Good housekeeping plays a key role in occupational health protection and is a way of preventing dispersion of dangerous contaminants. All work areas will be kept as clean as possible at all times, and spills will be cleaned up immediately. Housekeeping will be the responsibility of all employees.

W-C will implement a housekeeping program for the field activities to minimize the potential for slips, trips, and falls in the support zone. The program will include:

- Daily scheduling to police the area of debris, including paper products, cans, and other materials brought on site

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- **Periodic (daily minimum) removal of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing**
- **Any object capable of being blown away by high winds will not normally be left out of doors unless the object is secured to a fixed object.**

6.8.6 Emergency Equipment

The following emergency equipment will be stored in sealed plastic bags and will be available at each site of intrusive activity:

- **First aid kit**
- **Eye wash**
- **Gatorade or equivalent**
- **Fire extinguisher (10-lb ABC)**
- **An extra full set of the appropriate PPE for each team member**

6.8.7 Heat Stress Monitoring

Warm weather and several layers of protective clothing may induce heat stress in field employees. The SSO or HST will be responsible for monitoring personnel for signs of heat stress. Heart rate monitoring will be performed, at a minimum, every time employees break. At the beginning of the work day, at lunch break, and at the end of the day, workers must weigh in on a scale. Body water loss during the work day should not exceed 1.5 percent of total body weight. The amount of fluids lost must be replaced. Potable water and Gatorade, or other electrolyte replacement fluid, will be available. Workers should be encouraged to drink fluids during breaks. Attachment D presents W-C Operating Procedure No. HS-102, Heat Stress.

If a field worker's heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the work cycle by another one-third.

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be kept as clean as possible at all times, and spills will be cleaned up immediately
Housekeeping will be the responsibility of all employees

W-C will implement a housekeeping program for the field activities to minimize the potential for slips, trips, and falls in the support zone. The program will include

- Daily scheduling to police the area of debris, including paper products, cans, and other materials brought on site
- Periodic (daily minimum) removal of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing
- Any object capable of being blown away by high winds will not normally be left out of doors unless the object is secured to a fixed object

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The following emergency equipment will be stored in sealed plastic bags and will be available at each site of intrusive activity:

- First aid kit
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- Gatorade or equivalent
- Fire extinguisher (10-lb ABC)
- An extra full set of the appropriate PPE for each team member

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If a field worker's heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the work cycle by another one-third.

7.0 SITE-SPECIFIC HEALTH AND SAFETY REQUIREMENTS

7.1 INTRODUCTION

This section relates specifically to activities conducted at sites indicated on Plate 1 under the RFP Phase II RFI/RI 903 Pad, Mound, and East Trenches Areas (Operable Unit 2). Site-specific health and safety requirements generally consist of protective equipment, decontamination procedures, environmental monitoring, and work practices specified by the RFP. The personal protective equipment (PPE) needed to comply with the various levels of protection are detailed below.

7.2 PERSONAL PROTECTIVE EQUIPMENT

The level of PPE required for the various work areas will be continually reevaluated as field work progresses. It is expected that there will be a tailoring of requirements for specific sites and seasonal variations. PPE requirements for specific operations shall be agreed upon beforehand by the Site Manager, the HSO or CMHS, and the SSO, and a document to that effect will be drawn up, dated, and signed by the Site Manager and SSO. The SSO shall post PPE requirements in the crew trailer and announce changes and justification for those changes at a site safety meeting. The HSO or CMHS will publish a change to this plan if PPE changes are permanent and if the HSO/CMHS considers the change substantive.

7.2.1 Clothing Inspection

Personal protective equipment should be inspected before and during use. The following checks should be made before use:

- Determine that the clothing material is correct for the specific task at hand.

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- **Visually inspect for:**
 - **Imperfect seams**
 - **Tears**
 - **Malfunctioning closures**
- **Hold up to light and check for pinholes.**

During the work task, periodically inspect for the following

- **Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.**
- **Closure failure.**
- **Tears.**
- **Punctures.**
- **Seam discontinuities.**

Before using gloves, pressurize each glove to check for pinholes. To do so, blow or otherwise introduce air into glove, seal the wrist, and roll gauntlet toward fingers, or inflate the glove and hold it under potable water. In either case, no air should escape.

7.2.2 Personal Protective Equipment Levels

7.2.2.1 Level D

Level D may be used when the atmosphere contains no known hazard and when work functions preclude splashes, immersion, or the potential for unexpected inhalation of, or contact with hazardous levels of any radionuclides/chemicals. Level D consists of:

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- Uncoated Tyvek or equivalent disposable overall.
- Steel-toed boots with disposable boot covers.
- Additional seasonal items may be required. Any such items will be worn under the disposable overall.
- During intrusive activities coverall sleeves will be worn over the cuff of protective gloves and coverall legs will be worn over the upper portion of disposable boot covers. Tape will be used to seal the joints between coveralls, protective gloves, and cuffs.

7.2.2.2 Modified Level D

Modified Level D may be used in areas that can normally qualify for Level D, but where a potential hazard requiring quick transition to Level C may be present. Modified Level D consists of:

- Uncoated Tyvek or equivalent disposal coverall.
- Disposal chemical-resistant inner gloves worn over disposable cotton liners.
- Chemical-resistant outer gloves.
- Boots and chemical-resistant boot covers.
- Full-face respirator with organic vapor/HEPA cartridges ready for immediate donning.
- Additional seasonal items may be required. Any such items will be worn under the disposable overall.
- Personnel shall upgrade to Level C (don the respirator) in the event of dusty conditions or if organic vapor detectors or monitors indicate levels above background. Respirators will be stored inside sealed plastic bags until needed.
- Steel-toed boots and hard-hats.
- During intrusive activities coverall sleeves will be worn over the cuff of protective gloves and coverall legs will be worn over the upper portion of disposable boot covers. Tape will be used to seal the joints between coveralls, protective gloves, and cuffs.

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7.2.2.3 Level C

Level C consists of Modified Level D modified gear plus the full-face respirator, donned. The following constitutes Level C:

- **Uncoated Tyvek or equivalent disposal coverall.**
- **Disposable rubber boot covers (booties).**
- **Disposable chemical-resistant inner gloves worn over disposable cotton liners.**
- **Butyl or nitrile gloves.**
- **Boots, chemical-resistant, steel toe and shank.**
- **Disposable chemical-resistant boot covers.**
- **Full-face respirator with organic vapor/HEPA cartridges.**
- **Additional seasonal items may be required. Any such items will be worn under the disposable overall.**
- **Hard hats.**
- **During intrusive activities coverall sleeves will be worn over the cuff of protective gloves and coverall legs will be worn over the upper portion of disposable boot covers. Tape will be used to seal the joints between coveralls, protective gloves, and cuffs.**

7.2.2.4 Level B

Level B consists of the following:

- **Uncoated Tyvek or equivalent disposable coverall.**
- **Saranex-coated outer coveralls with hood - all joints taped and sealed.**
- **Disposable chemical-resistant inner gloves worn over disposable cotton liners.**
- **Butyl or nitrile gloves.**
- **Boots, chemical-resistant, steel toe and shank.**
- **Disposable chemical-resistant boot covers.**
- **Pressure-demand, full-facepiece, self-contained breathing apparatus (SCBA) or supplied air respirator with escape SCBA.**

- Steel-toed boots and hard hats.
- Additional items may be required in specific locations or tasks.
- During intrusive activities coverall sleeves will be worn over the cuff of protective gloves and coverall legs will be worn over the upper portion of disposable boot covers. Tape will be used to seal the joints between coveralls, protective gloves, and cuffs.

7.2.2.5 Respirators

Personnel are trained, fitted, and issued personal respirators for use during intrusive activities and for work at the equipment decontamination pad. Each individual is responsible for inspecting and maintaining his or her own respirator. W-C Operating Procedure No. HS-203 (Attachment D) provides general procedures for cleaning, inspection, maintenance, and storage of respirators. Procedures specific to operations within OU2 are provided in this Section.

Each individual is responsible for the cleaning, inspecting, maintenance, and storage of any respirator they use. Before being taken to the field, all respirators will be inspected, cartridges (if used) installed, a positive and negative pressure check conducted and then the entire respirator assembly will be sealed in a plastic bag. And, the respirator will remain in the sealed bag until needed. If the respirator is not used and the sealed bag is not damaged, the respirator may be left at the worksite inside an area protected from the elements. The enclosed cab of a vehicle is considered to be one example of a protected area.

After the respirator is used, the following procedures will be used. Cartridges from air purifying respirators will be removed and disposed of as contaminated PPE. The respirator face piece interior and exterior will be wiped down with premoistened towellingettes such as baby wipes and subsequently sealed in a plastic bag for transport to the respirator cleaning station at the shower trailer. The respirator interior and exterior will be wipe tested for radioisotopes before being cleaned if radioactivity was detected while the respirator was being used. If the wipe test indicates the presence of radioactivity, the respirator will be thoroughly wiped down with baby wipes (or equivalent) and wipe tested again. The used baby wipes will be disposed of as contaminated PPE. If the second wipe test indicates the presence of radioactivity, the respirator

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will be sealed in a plastic bag, the bag will be labeled to indicate the presence of radioactivity on the respirator and the SSO contacted. Respirators found to be radiologically contaminated will not be placed in the cleaning and rinse solutions at the shower trailer. After a respirator has been cleaned and rinsed, it will be patted dry with a clean towel and stored.

7.2.2.6 Personal Protective Equipment for Decontamination Workers

All team members responsible for conducting equipment decontamination at the vehicle decontamination station will wear the following Level C protective ensemble:

- Uncoated Tyvek or equivalent coveralls.
- Saranex-coated coveralls over uncoated coveralls.
- Steel-toed boots.
- Disposable boot covers.
- Disposable inner gloves.
- Butyl (chemical resistant) or nitrile exterior gloves.
- Full-face respirator with organic vapor/HEPA cartridges.
- Level B respiratory protection is required when decontaminating equipment known to be contaminated with radioisotopes.

7.3 REQUIRED LEVELS OF PPE PER TASK AND IHSS

7.3.1 Level D PPE

Surveying, staking, and nonintrusive geophysics may be accomplished in Level D PPE inside each IHSS and Outlying Area within OU2.

Main decontamination facility (MDF) maintenance operations that do not have a potential for splashes occurring will be accomplished in Level D PPE. If simple splashing (versus using a pressurized spray) is a potential hazard, a Saranex coverall will be worn in place of an uncoated

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Tyvek coverall and either goggles designed to protect against splashes or a face shield will be worn.

Core logging activities for uncontaminated cores will be accomplished in Level D PPE and surgical type gloves. "Uncontaminated cores" are defined as soil cores collected without the OVD indicating organic vapor levels above background and without the RFP 881 Laboratory detecting an activity of greater than 50 pCi/g.

7.3.2 Level Modified D PPE

With the exclusion of the 903 Pad (IHSS No. 112), well drilling, soil boring, soil scraping, trenching, core logging of potentially contaminated cores and packer testing will be accomplished in Modified Level D. Potentially contaminated cores are defined as those soil cores that do not meet the definition of uncontaminated cores (see Subsection 7.3.1).

7.3.3 Level C PPE

Within the 903 Pad (IHSS No. 112), well drilling/construction, soil boring, soil scraping, trenching, and packer testing will be accomplished in Level C PPE.

MDF maintenance operations that entail the use of pressurized sprays or opening containers of wastes generated at either the MDF or at field sites will be accomplished in Level C PPE with a Saranex coverall worn as the outer most layer.

7.4 MONITORING INSTRUMENTS

Direct-reading real-time monitoring will be conducted.

- An organic vapor detector (OVD) (photoionization or flame ionization) and a Dräger hand pump with detector tubes for carbon tetrachloride (CCl_4) and vinyl chloride will be used to monitor for nonradioactive substances.

- A Ludlum Model 12-1A will be used to monitor dry equipment surfaces and dry PPE for the presence of alpha-emitting radioisotopes.

7.5 MONITORING STRATEGIES

An HST will be assigned to each field team and the MDF maintenance team. The individual logging cores will be responsible for conducting monitoring during the core logging process. The HST will conduct real-time monitoring as described below and provide monitoring results to the SSO.

7.5.1 Real-Time Monitoring

Real-time monitoring will be conducted to provide an indication of the presence of potential hazards.

7.5.1.1 OVD

An OVD will be used at each site of intrusive activity, the MDF, and during core logging operations.

- When soil boring and well construction activities are under way, the interior of the auger(s) will be monitored each time the auger is opened to add another auger flight. An OVD measurement result greater than background inside the auger will be cause to initiate OVD measurements in the breathing zone of the individual most likely to be exposed, such as the driller or the driller's helper. Results of breathing zone measurements will be compared to the action levels established in Subsection 7.6.
- When trenching activities are under way, the interior of the trench will be monitored before sampling of the trench wall is allowed to begin. OVD measurements made inside the trench will be treated as breathing zone measurements for the purposes of using action levels established in Subsection 7.6.

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- An organic vapor detector (OVD) will be used to monitor the head space inside sealed containers of waste fluids from the field and when opening holding tanks containing wastes generated at the MDF. If the organic vapor concentration is greater than background, the individual will leave the head space open, move upwind, let the head space vent for ten minutes. Afterwards, the organic vapor concentration will be remeasured. If the organic vapor concentration is at the background level respiratory protection is not required, but the organic vapor concentration will periodically be measured in the worker's breathing zone. If the organic vapor level in the head space does not drop to background level the action levels established in Subsection 7.6 will be applied.
- When logging cores, an OVD will be used to monitor the core surface of potentially contaminated cores before the logging procedure begins. Results of the core surface monitoring will be compared to the action levels established in Subsection 7.6 and the appropriate action taken.
- Measurements with an OVD are not required during surficial soil sampling activities or packer testing.

7.5.1.2 Detector Tubes for Carbon Tetrachloride

A Dräger handpump with detector tubes for carbon tetrachloride will be used during all intrusive activities. The monitoring strategy will be the same as is described for an OVD during soil boring and trenching activities in Subsection 7.5.1.1.

7.5.1.3 Detector Tubes for Vinyl Chloride

A Dräger handpump with detector tubes for vinyl chloride will be used during all intrusive activities accomplished within the Outlying Area directly north of the Mound Area. The monitoring strategy will be the same as is described above in Subsection 7.5.1.1.

7.5.1.4 Ludlum Model 12-1A Count Rate Meter

A Ludlum Model 12-1A Count Rate Meter will be used at each site of intrusive activity. The Ludlum probe will be placed as close as possible and parallel to the material being monitored. In no case, should the probe be held farther than $\frac{1}{4}$ inch from the surface being measured. When monitoring, do not move the probe faster than 1 inch/second. However, the probe should not come in contact with the material being monitored. If activity is detected, the probe will be held stationary for a quantitative measurement. Soil cuttings, equipment, and PPE that are dry will be monitored with the Ludlum probe, although any surface that is dry may be monitored.

A health and safety technician (HST) that is familiar with how to operate a Ludlum Model 12-1A will be present at each activity that requires monitoring with a Ludlum Model 12-1A. The HSTs are considered to be semi-skilled radiation monitors and will conduct day-to-day monitoring activities, immediately implement the action levels in Subsection 7.6, and notify the site safety officer (SSO) of all monitoring results. The SSO will arrange for a skilled radiation monitor (SRM) to verify HSTs radiation monitoring results that indicate the presence of greater than 250 counts per minute (cpm). An SRM will have indepth familiarity and experience in radiation monitoring.

- During soil boring and well construction, the ground surface to be penetrated by the initial auger flight will be monitored before the auger bit is set on the ground, and soil cuttings will be wetted as they are brought to the surface (see Subsection 7.7.3). When the auger is stopped so that another flight may be added, the wetted soil cuttings will be removed. As additional (dry) soil cuttings are brought to the surface, a small (approximately 1 cup) sample will be collected and the wetting process of the remaining cutting will begin immediately. The soil sample will be spread on a smooth surface and monitored with the Ludlum probe. The results of monitoring will be compared to the action levels established in Subsection 7.6.

- When trenching activities are under way, the Ludlum probe will be used to monitor the soil surface to be excavated before trenching begins. The interior wall of the trench will be monitored before sampling of the trench wall is allowed to begin. The results of measurements made with the Ludlum probe will be compared to the action levels established in Subsection 7.6.
- During surficial soil sampling activities, the soil surface to be sampled will be monitored with a Ludlum probe. The results of monitoring will be compared to the action levels established in Subsection 7 6.
- During maintenance activities at the MDF all surfaces will be monitored for radiological contamination following decontamination of equipment known to be radiologically contaminated. A Ludlum Model 12-1A will be used to monitor dry surfaces and the action levels established in Subsection 7 6 will be applied.
- During core logging a Ludlum Model 12-1A will be used to monitor the core surface of potentially contaminated cores before the logging procedure begins and remonitoring of the core material will be accomplished periodically. The action levels established in Subsection 7.6 will be applied.
- Measurements with a Ludlum probe are not required when packer testing is under way.

7.5.1.5 Piezobalance Aerosol Mass Monitor

The piezobalance will be used to indicate the amount of particulate matter being generated so that the potential for spreading contamination is minimized. A piezobalance aerosol mass monitor will be placed downwind of intrusive activities and as close to the intrusive activity as feasible without interfering with the intrusive activity. The concentration of airborne particulate matter indicated by the piezobalance will be compared to the action levels established in Subsection 7.6.

7.5.1.6 Anemometer

An anemometer will be used to indicate wind speed during intrusive activities. The anemometer will be positioned upwind of the intrusive activity but close enough to the work site to permit ready access. Intrusive activities will not be conducted when sustained wind speeds above 35 miles per hour (mph) exist as measured by the anemometer. Sustained winds above 35 mph exist when the 15-minute average wind-speed exceeds 35 mph for two consecutive 15-minute periods.

7.5.2 Air Sampling

Air samples will be collected and a laboratory analysis conducted for substances classified as either potential inhalation hazard or an inhalation hazard (see Subsection 5.2.3). The substances to be sampled for, geographical areas in which sampling will occur, and sample collection procedures are specified in Subsections 7.5.2.1. and 7.5.2.2.

7.5.2.1 Vinyl Chloride

Vinyl chloride (see Subsection 5.3.2.11) will be sampled for during soil boring activities within the outlying area north of the Mound Area (IHSS No. 113) at "proposed plume characterization alluvial monitor well" numbers 32-91, 33-91, and 34-91 (see Plate 1). The sample collection will be accomplished as described in National Institute of Occupational Safety and Health (NIOSH) method 1007. NIOSH method 1007 is provided as Attachment K.

7.5.2.2 Radioisotopes

Radioisotopes (Pu-239 and Am-241) (see Subsections 5.3.2.1 and 5.3.2.2) will be sampled for during soil boring and surficial soil sampling activities conducted within the 903 Pad (IHSS No. 112) and the 903 Pad Lip Site (IHSS No 155). NIOSH has not published an air sampling methodology specifically for radioisotopes. Therefore, the following procedures will be utilized.

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A three-piece, 37-millimeter air monitoring cassette containing a Type A/E 1 μ m glass fiber filter will be used in the openface mode to collect airborne dust. A minimum air sample volume of 1 cubic meter is required, although 2 cubic meter air samples are desirable. A personal sampling pump with a representative sampler in line will be calibrated before and after each sampling event. A "bubble meter" will be used as the calibration standard.

7.6 ACTION LEVELS

All decisions regarding application of the following action levels for non-radioactive substances will be based upon breathing zone measurements. The action level for measurements of radioisotopes with the Ludlum Model 12-1A probe will be based upon surface measurements of dry soil, equipment, or PPE. The HST will notify the SSO immediately after any upgrade in PPE.

<u>Instrument</u>	<u>Action Level</u>	<u>Action</u>
OVD	greater than background greater than 5 ppm	Don Level C PPE Don Level B PPE
Carbon Tetrachloride Detector Tube	greater than 1 ppm greater than 50 ppm	Don Level C PPE Don Level B PPE
Vinyl Chloride Detector Tube	greater than 0.5 ppm greater than 25 ppm	Don Level C PPE Don Level B PPE
Ludlum Model 12-1A	greater than 250 counts per minute greater than 1250 counts per minute	Don Level C PPE and notify SSO Don Level B PPE and notify SSO
Piezobalance	6 milligrams/cubic meter	Curtail intrusive activities and contact the subcontractor's site manager
Anemometer	35 mph	See Subsection 7.5.1.6

7.7 WORK PRACTICES

7.7.1 Equipment Monitoring

Equipment decontamination will be accomplished by persons wearing the PPE specified in Subsection 6.10 of this plan. RFP Environmental Restoration Program Standard Operating Procedures (SOPs) establish monitoring, decontamination and record keeping requirements for equipment items. The following requirements are in addition to those established by the SOPs.

- Each equipment item will have an identification number stamped on it or otherwise permanently attached if such an identification number is not already present. This requirement applies to vehicles, augers and drill rods.
- A radiation monitoring log will be established for each equipment item with an assigned identification number. Results of all monitoring will be recorded in the log and will, as a minimum, include prework monitoring and post work monitoring.
- The air filter of each engine that operates within an exclusion zone as intrusive activities progress will be radiologically monitored when it is replaced with a new filter and after its last use during intrusive activities at RFP. Monitoring will be accomplished by wetting the filter element, disassembling the filter and using a Ludlum Model 12-1A to monitor the dirtiest portion of the filter after it has dried.
- Any surfaces of a vehicle or other equipment item that contacts the ground surface as it is being moved from a site of intrusive activity to another will be radiologically monitored with a Ludlum Model 12-1A immediately before it moves onto a public thoroughfare.

This requirement applies to items that have been used in any area that is either known to have surficial radiological contamination or such contamination was noted as the item was used on the field. Vehicles/items found to be contaminated immediately prior to moving onto a public thoroughfare will be handled as described in the appropriate RFP Environmental Restoration Program SOP.

- Before rented or leased equipment that has been used in the field is returned, it will be wipe-tested for radioisotopes and the results furnished to the HSO. The HSO will determine if the item is suitable for return to the owner.

7.7.2 Geophysics

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As stated earlier, this Health and Safety Plan does not address the hazards associated with drilling into buried waste containers (filled containers such as in Trench T-1, or flattened containers such as may be found in other trenches). Therefore, geophysics will be employed before drilling or excavating into any trench. If an auger encounters a buried waste container, drilling will cease, all down-hole equipment will be removed from the hole, and radiation screening will be accomplished. Decontamination of equipment and personnel will be accomplished and the drilling operation will be relocated.

7.7.3 Intrusive Activities

All subsurface soils brought up to the ground surface shall be wetted immediately to limit the potential for dust becoming airborne. Soil samples collected for analysis are excluded from this requirement. In general, a hand-pressurized, garden-type sprayer should be used. The sprayer nozzle will be adjusted so that a mist (versus a pressurized stream) will be used to moisten the soil. The soil cuttings should not be saturated, since that could lead to the spreading of potential contamination by water runoff from the soil cuttings.

Personnel will not enter trenches that are deeper than four feet at the deepest point without approval of the HSO. The HSO will provide instructions for shoring and other safety measures.

7.7.4 Work During Darkness

This Health and Safety Plan does not cover field work after daylight hours.

7.7.5 Confined Work Space

No work in confined spaces or places with limited egress is permitted by this plan.

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7.7.6 Core Logging

Potentially contaminated cores (see Subsection 7.3.2) will be logged out-of-doors within an exclusion zone.

8.0 EMERGENCY RESPONSE PROCEDURES

8.1 RADIO COMMUNICATIONS

Field teams will have a method of communicating with both the field office trailer and other field teams.

A communication center will be established at the W-C field trailer office. This office will be equipped with telephone communications and shall be attended at all times during operations.

8.2 EMERGENCY TELEPHONE

The closest accessible telephone during all working hours will be identified by the SSO before beginning field activities in case communication with the W-C communications center is not possible. All guard posts have telephones. Emergency telephone numbers will be posted near the W-C field office telephone.

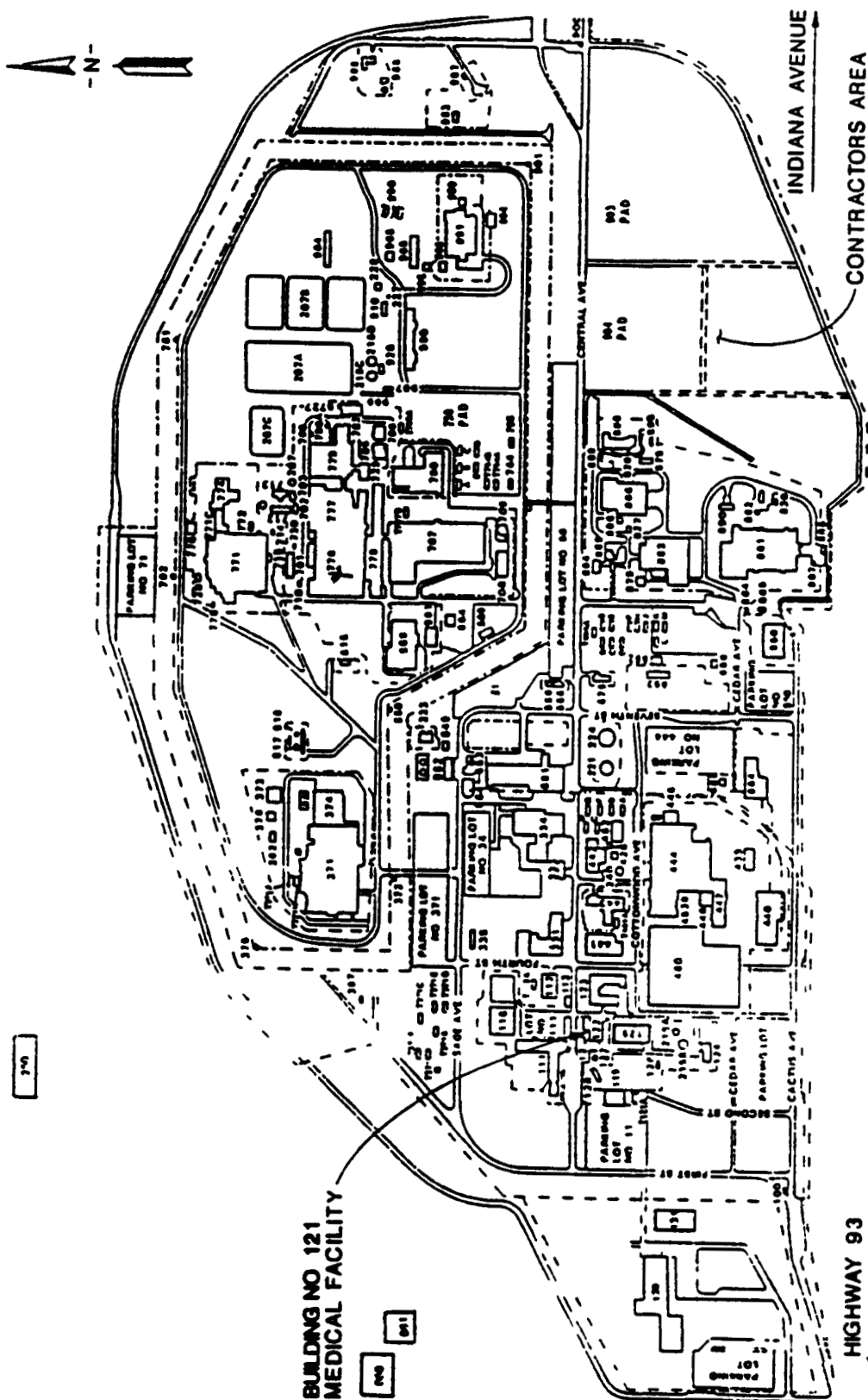
8.3 MEDICAL FACILITIES

Telephone numbers for the RFP medical facility are provided below (Building 122, Central Avenue) (See Figure 8-1):

- General Information 966-2594
- Ambulance Service 966-2911

8.4 EMERGENCY RESPONSE PROCEDURES

The Site Manager, with assistance from the SSO, has responsibility and authority for coordinating all emergency response activities until proper authorities arrive and assume control.



Health & Safety Plan (Accident Prevention Safety Program Plan) Rocky Flats
 Plant Phase II RFI/RI 903 Pad Mound and East Trenches Area (Operable Unit
 2) Rocky Flats Plant April 1991
 Document Control Number RF/RMRS-97-079 Revision 0 0
 EG&G, Rocky Flats Inc

U.S. DEPARTMENT OF ENERGY
 Rocky Flats Plant, Golden, Colorado
 OPERABLE UNIT 2
 PHASE II RFI/RI HEALTH AND SAFETY PLAN

MEDICAL FACILITY MAP

Figure 8-1

8.4.1 Fire/Explosion

Fire emergencies will be handled by immediately notifying the fire department. Only if a fire appears to be small and easily extinguishable, will personnel attempt to control it with fire extinguishers available in the work area. Otherwise, immediate evacuation of the area is indicated. In the event of an explosion, all personnel shall be evacuated and the fire department notified. No one shall re-enter the area until it has been cleared by explosives safety personnel.

8.4.2 Physical Injury

In case of injuries to personnel, first aid treatment will be initiated immediately by trained personnel. In case of serious injuries, the victim will be transported to the Rocky Flats Plant medical center as soon as possible. Minor injuries may be treated on site, but all injured personnel will be transferred to the nearest recommended medical treatment facility and examined by trained medical personnel. Victims of serious bites or stings will be taken to the RFP medical center. In the event that an injured person is contaminated with chemicals or radionuclides, the person shall be taken to the RFP medical center as soon as possible. Decontamination shall be performed to prevent further exposure only if it will not aggravate the injury. Treatment of life-threatening or serious injuries will always be considered first.

8.4.3 Injury Due to Heat

If a person is suffering from heat exhaustion (profuse perspiration, normal body temperature), the following procedures will be taken:

- Remove the person to a cooler, shaded area.
- Give 8 ounces of Gatorade (if available) every 15 minutes for three or four doses. Drinking water will be used if Gatorade is not readily available.
- Allow the person to rest.
- If the person is suffering from cramps, press warm, wet towels over the cramped area.

A life threatening situation exists and immediate action is indicated if a person is suffering from heat stroke (skin hot and dry, very high body temperature), the following procedures will be taken:

- **Immediately contact the SSO and request the medical facility be alerted to the situation.**
- **Cool the victim quickly by soaking the person in cool but not cold water, sponging the body with rubbing alcohol or cool water, or pouring water on the body.**
- **Transport to hospital for medical attention as quickly as possible.**

8.4.4 Injury Due to Cold

First aid for frostbite consists of the following procedures:

- **Decontaminate the victim.**
- **Bring the victim indoors and quickly rewarm the affected areas in water between 102° to 105°F.**
- **Give victim a warm drink--NOT coffee, tea, or alcohol.**
- **Do not permit the victim to smoke.**
- **Keep the frozen parts in warm water or covered with warm cloths for 30 minutes, even though the tissue will be painful as it thaws.**
- **Evaluate the injured areas and cover with sterile, soft, dry material.**
- **Keep the victim warm and get immediate medical care.**

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- Do not rub the frostbitten part.
- Do not allow blisters to be broken.
- Do not use ice, snow, or anything cold on frostbite.
- Do not use heat lamps or hot water bottles to rewarm the body part.
- Do not place the affected part near a hot stove.

First aid for excessive exposure to cold (hypothermia) consists of the following procedures:

- Decontaminate the victim.
- Bring victim into a warm area as quickly as possible.
- Remove wet or cold garments.
- Dry the person thoroughly.
- Provide warm, dry clothing or covering.
- Provide rapid but gentle rewarming.
- Give victim a warm drink--NOT coffee, tea, or alcohol.
- Keep the victim warm and get immediate medical care.

8.4.5 Emergency Services

Emergency telephone numbers are listed in Table 8-1.

8.4.6 Notification Requirements

Reporting and notification of emergency situations shall be carried out in accordance with requirements in Department of Energy (DOE) Order 5484.1. The Team Leader of the field team involved will notify the site safety officer who will notify the appropriate emergency assistance personnel (for example, fire, police, ambulance) at extension 2911 immediately, and

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then notify the Site Manager. The Site Manager will notify the EG&G Environmental Restoration (ER) Program Field Supervisor, PM, and HSE Area Safety Engineer. The responsibility of the SSO is to implement notification and reporting requirements of DOE Order 5484.1.

8.4.7 Spills

Current plans do not include handling the types or quantities of materials that, if spilled, would create a health hazard or generate environmental concerns. However, the SSO should be notified of all chemical spills for a determination of how to clean up and dispose of cleanup materials. Attachment C provides instructions for managing spills of some materials that may be found at RFP.

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**TABLE 8-1
EMERGENCY TELEPHONE NUMBERS**

Site Health and Safety Officer Gregg Miller	(303) 966-5874
Business Unit Health and Safety Officer Mike Sams	(303) 740-2700
WCFS Corporate Manager, Health and Safety Jerry Andersen	(303) 740-2700
24-Hour Installation Health/Safety Coordinator	(303) 966-2911
Fire	(303) 966-2911
Ambulance	(303) 966-2911
Poison Center	(303) 629-1123
Security	(303) 966-2911
Police	(303) 966-2911

THE W-C TRAILER IS LOCATED AT: 901 Contractor's Pad in Trailer No 22

**NEAREST MEDICAL
SERVICES ARE LOCATED AT:** Building 122

Directions:

From the Contractor's trailer compound, take a northbound street to Central Avenue and turn left onto Central Avenue: Building 122 will be on the left side and slightly west of a guard building on the right after approximately 1.25 miles

From the RFP eastern boundary, upon entering RFP off of Indiana Street, you will be on Central Avenue. Proceed approximately 3.5 miles: Building 122 will be on the left side.

From the RFP western boundary at Hwy. 93, proceed along the entrance road to just past the gate, at which time you will be eastbound on Cactus Avenue. Then turn left onto the first street past Second Street, (Third Street, which is not marked) Proceed up Third Street past Building 125, which is on the left: the next building on the left will be the medical facility (Building 122)

9.0 LOGS, REPORTS, AND RECORDKEEPING

9.1 GENERAL

Records shall be kept documenting the site safety program. A bound logbook will be used by the SSO/HST to record results of each environmental monitoring event within the exclusion zone, including those events specified below:

- Radiological
 - Ludlum Model 12-1A count rate meter
 - Other (specify in log book)
- Ambient Air
 - Photoinization detector
 - Organic vapor monitor
 - Piezobalance
 - Anemometer
 - Other (specify in log book)

9.2 PERSONNEL RECORDS

Records shall be kept on each on-site individual. Records include a medical clearance statement from a qualified physician, fit test, and training documentation. When site safety meetings are conducted, an attendance sheet must be kept.

9.3 CALIBRATION RECORDS

All monitoring equipment used for health and safety purposes will be calibrated as suggested by the manufacturer and records of calibration will be maintained.

9.4 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION FORM (OSHA Fm) 200

An OSHA Form 200 will be posted in an area frequented by all subcontractor personnel. The SSO will be responsible for maintaining the form.

10.0
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ATTACHMENT A

NARRATIVE OF WILDLIFE FOUND AT ROCKY FLATS PLANT

The animal life inhabiting the Rocky Flats Plant (RFP) and its buffer zone consists of species associated with western prairie regions. The most common large mammal is the mule deer, with an estimated 100-125 permanent residents. There are a number of small carnivores, such as the coyote, red fox, striped skunk, and long-tailed weasel. A profusion of small herbivores can be found throughout the plant and buffer zone consisting of species such as the pocket gopher, white-tailed jackrabbit, and the meadow vole (U S. DOE, 1980).

Bull snakes and rattlesnakes are the most frequently observed reptiles. Eastern yellow-bellied racers have also been seen. The eastern short-horned lizard has been reported on the site, but these and other lizards are not commonly observed. The western painted turtle and the western plains garter snake are found in and around many of the ponds (U.S. DOE, 1980).

Diseases that are endemic to the front range of the Rocky Mountains and, therefore, on RFP include: Plague, Rocky Mountain Spotted Fever, and Rabies. Each of those diseases is associated with one or more mammals inhabiting RFP.

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ATTACHMENT B

CHARACTERISTICS OF RADIOISOTOPES FOUND IN OPERABLE UNIT NO 2 (OU-2)

The DOE Rocky Flats Plant produces "triggers" for nuclear weapons, which involves the processing and machining of plutonium, as well as the use of beryllium and other materials. Uranium and other radionuclides are known to be present on the site, either from process operations or from the disposal of wastes from other facilities.

Normal process releases from this facility are reported to be minimal, although there are several historical incidents that have released significant quantities of contaminants.

Plutonium can spontaneously combust in air, a characteristic which contributed to serious fires that released plutonium to the environment in 1957 and 1969. In 1969 a glovebox fire resulted in the release of several kilograms of plutonium to the environment. Analysis of soil samples, taken mostly east of DOE property, found up to 6 pCi/g on the top centimeter of soil (background is 0.04 pCi/g) shortly after this fire. In 1974 there was another accidental release of plutonium to the air.

Starting in 1958, barrels containing used machining fluids were stored outdoors at a location now called the 903 Pad. Leakage from the barrels was discovered in 1964. By 1968, the last barrels had been removed and the area was monitored for alpha activity. Levels of up to 13.5 μ Ci/g of soil were found, with activity penetrating to 8 inches deep. Rocks were removed from the area and fill was applied to the storage area, which was then paved. Additional fill was added to the area surrounding the 903 Pad in 1970 after soil sample analysis revealed greater than 50 pCi/g of alpha activity.

Other sites on the facility that may be significant contaminant sources include the West Spray Fields, an area east of the plant used for burial called the East Mounds, the 881 Hillside area, and the solar evaporation ponds. With the exception of the West Spray Fields, all of these locations are to the east of the new sanitary landfill sites.

The distribution of radioactive dusts in the environment is driven by prevailing wind patterns and drainage patterns at the Plant site. Both the prevailing winds and drainage patterns are west-to-east, with a significant north/south component for prevailing winds. This can be verified

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by the distribution of radionuclides in the soil as reported by Rocky Flats Plant annual environmental reports.

Expected concentrations of plutonium near the areas of this work is thought to be approximately 0.05 pCi/gm (0.02 pCi/g [0.04 dis/min/g] is considered background). This level is well below levels considered hazardous. Reasonable dust control measures in areas containing 0.05 pCi/gm will provide adequate protection against exposure to plutonium by inhalation.

Elevated levels of plutonium have been measured in various areas in the buffer zone around the Rocky Flats Plant, primarily to the east of the facility. The highest levels of plutonium measured are to the east and south of the Plant, with the principal source being the 903 Pad Soils at Indiana Avenue have been found to have an activity of 7.34 pCi/g.

Radionuclides of Concern

Pu^{239}

The predominant isotope present as an environmental contaminant is Pu^{239} . Major radiations from this material include the following:

alpha (He^{2+})	5.16 MeV (88%)
	5.11 MeV (11%)

Pu^{239} emits very little gamma (photons) of low energy, the most important being:

0.052 MeV (0.020%)

Pu^{239} is beta (e^-) stable.

The radiation of concern (alpha) is not sufficiently penetrating to penetrate the dead layers of the skin, which means Pu^{239} is not an external hazard. However, it is very important to avoid

inhalation or ingestion of this material, as alpha radiation may be very damaging from within the body.

Am²⁴¹

Am²⁴¹ is a contaminant of weapons-grade plutonium, present at less than 20% of the concentration of Pu²³⁹. Major radiations from this material include the following:

alpha (He ²⁺)	5.49 MeV (85%)
	5.44 MeV (13%)

Am²⁴¹ emits some gamma (photons) of low energy, the most important being:

0.060 MeV (36%)

Am²⁴¹ is beta stable.

The radiation of concern (alpha) is not sufficiently penetrating to penetrate the dead layers of the skin, which means Am²⁴¹ is not an external hazard. However, it is very important to avoid inhalation or ingestion of this material, as alpha radiation may be very damaging from within the body.

U²³⁵

U²³⁵ is also known to be present in some soils at this site. U²³⁵ is normally present as 0.7 percent of the total uranium present. Major radiations from this material include the following:

alpha (He ²⁺)	4.58 MeV (8%)
	4.40 MeV (57%)
	4.37 MeV (18%)

Gamma emissions are principally due to the presence of thorium daughter radiations, the most important being:

98

0.143 MeV (11%)

0.185 MeV (54%)

0.204 MeV (5%)

U^{235} is beta stable.

The radiation of concern (alpha) is not sufficiently penetrating to penetrate the dead layers of the skin, which means U^{235} is not an external hazard. However, it is very important to avoid inhalation or ingestion of this material, as alpha radiation may be very damaging from within the body. At concentrations much higher than are expected to be present at this site, U^{235} can be an external hazard from daughter gamma emissions.

U^{238}

U^{238} is also known to be present in some soils at this site. U^{238} is normally present as 99.276 percent of the total uranium present. Major radiations from this material include the following:

alpha (He^{2+})	4.20 MeV (75%)
	4.15 MeV (25%)
	4.37 MeV (18%)

Gamma emissions are principally due to the presence of daughter radiations, principally from Th^{234} and Pa^{234m} .

Beta emissions include:

(e^-)	0.030 MeV
	0.043 MeV

The radiation of concern (alpha) is not sufficiently penetrating to penetrate the dead layers of the skin, which means U^{238} is not an external hazard. However, it is very important to avoid inhalation or ingestion of this material, as alpha radiation may be very damaging from within

the body. At concentrations much higher than are expected to be present at this site, U^{238} can be an external hazard from daughter gamma emissions. The beta emissions are not sufficiently energetic to penetrate the outer (dead) layers of skin.

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ATTACHMENT C

CHARACTERISTICS OF NONRADIOACTIVE HAZARDOUS SUBSTANCES FOUND IN OPERABLE UNIT 2 (OU2)

NOTE The reader should keep in mind that a material safety data sheet for a given substance provides information concerning the substance in a relatively pure form and that the substances that may be encountered during this project will be at very low concentrations from the view point of significant occupational exposures

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 ppm (skin) (See Sect. II)

Carbon tetrachloride is highly toxic and irritating by inhalation and ingestion (mean lethal dose is 5-10 ml). It is toxic by skin absorption. Excessive exposure may result in CNS depression and/or gastrointestinal symptoms.* It is irritating to skin and eyes. Eye contact or systemic effects can produce visual disturbances (haze, blind spots, narrowing of visual field, etc.). Skin contacts can cause defatting & dermatitis.

Kidney & liver damage can occur from severe acute or chronic exposure. It is a suspected carcinogen in humans.

FIRST AID:

Eye Contact: Flush eyes with running water for 15 minutes, including under the eyelids.
Get medical help if irritation persists or when visual disturbances occur.

Skin Contact: Remove contaminated clothing promptly. Wash exposed skin with soap and water. Get medical help for repeated or gross exposures.

Inhalation: Remove to fresh air. Restore and/or support breathing; have qualified person administer oxygen if needed. Get medical help.

Ingestion: Contact physician for gastric lavage. (If medical help and advice is not readily available, give water to drink and induce vomiting.)

***Also cardiac arrhythmias.**

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel when large spills occur. Evacuate area. Provided maximum exhaust ventilation. Clean-up personnel must use protection against contact and inhalation (see Sect.VIII). Contain spill; pick up liquid for disposal. Small spills and residues can be absorbed on paper, vermiculite, etc. and allowed to evaporate in a hood. Prevent release of CCl_4 to surface water or sewers. Spills or discharges in 24 hours of 5000 lb or more (proposed RQ^a is 1000 lb) must be reported to U.S. Government.

DISPOSAL: Consider recovery and reuse, if feasible. Scrap may be burned in approved, high temperature incinerator with scrubber or it may be disposed of as hazardous waste (EPA number U211 or F001) as a spent degreasing solvent under RCRA). Follow Federal, State and Local regulations.

*Reportable Quantity.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV. Exhaust hoods need 100 fpm min. face velocity. Ventilate sumps and low lying areas. Use air-supplied or self-contained respirators above TLV, with full face piece above 100 ppm.

PVA or neoprene gloves and protective clothing needed to prevent skin contact. Wear safety goggles and/or face shield for eye protection.

An eyewash station and chemical safety shower should be readily accessible.

Provide preplacement and twice a year medical exams. Workers with obesity, diabetes, alcoholism or pulmonary problems should have a physician's approval before working with CCL4. Retain medical records for 30 years after termination of employment.

Provide training to those exposed to CCl_4 in the workplace. Monitor vapor levels in the workplace.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated, low fire-risk area.

Protect containers against physical damage. Keep away from sources of heat, direct sunlight, and incompatible materials (see Sect. V). Prevent exposure of vapors to high temperature to prevent decomposition to toxic and corrosive gases and vapors. No smoking in areas where vapors may be present.

Prevent contact with the skin or eyes. Avoid exposure to vapors. Use good personal hygiene.

CCl₄ toxicity is markedly increased by the synergistic effects of alcohol. When possible, substitute a less hazardous solvent for CCl₄. DOT Classification - ORM-A

DATA SOURCE(S) CODE: 1-12,15,16,21-26,31,37,38,41

APPROVALS: MIS
CRD

Industrial Hygiene and Safety

MEDICAL REVIEW: 16 Dec. 1980

According to the findings of computer work on children's drawings are created, children's drawings, however, through research that has been done in the production of the computer program "Drawing Computer" to be more than the "drawing" of the child, to be able to do so in the ability of children to work together to produce a drawing of the child in the production of the child.

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Occupational Health Guideline for 1,1-Dichloroethane

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data, rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_3CHCl_2
- Synonyms: Asymmetrical dichloroethane; ethylidene chloride, 1,1-ethylidene dichloride
- Appearance and odor: Colorless liquid with a chloroform-like odor

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,1-dichloroethane is 100 parts of 1,1-dichloroethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 400 milligrams of 1,1-dichloroethane per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for 1,1-dichloroethane a Threshold Limit Value of 200 ppm.

HEALTH HAZARD INFORMATION

- Routes of exposure
1,1-Dichloroethane can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- Effects of overexposure
1. Short-term Exposure: Breathing 1,1-dichloroethane vapor may cause drowsiness and unconsciousness. It might also cause damage to the liver, kidneys, and lungs. Splashing the liquid in the eyes may cause irritation

2. Long-term Exposure: Prolonged, confined, or repeated skin contact with 1,1-dichloroethane can produce a slight burn.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 1,1-dichloroethane.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to 1,1-dichloroethane at potentially hazardous levels

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 1,1-dichloroethane exposure.

—Skin disease: 1,1-Dichloroethane can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although 1,1-dichloroethane is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function

—Kidney disease: Although 1,1-dichloroethane is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 1,1-dichloroethane might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

1,1-Dichloroethane vapor is a narcotic. Rats exposed to 32,000 ppm for 30 minutes did not survive. The most consistent findings in animals exposed to concentrations

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

of above 8,000 ppm for up to 7 hours were pathologic changes in the kidney and liver, and at much higher concentrations, near 64,000 ppm, damage to the lungs as well. Repeated daily exposure of several species of animals to 1,000 ppm resulted in no pathologic or atologic changes. The liquid applied to the intact or ded skin of rabbits produced slight edema and very slight necrosis after six daily applications. Instilled in the eyes of rabbits there was immediate, moderate conjunctival irritation and swelling which subsided within a week. There have been no reported cases of human overexposure by inhalation; prolonged, confined, or repeated skin contact can produce a slight burn.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 99
2. Boiling point (760 mm Hg) 57.3 C (135 F)
3. Specific gravity (water = 1): 1.2
4. Vapor density (air = 1 at boiling point of 1,1-dichloroethane): 3.4
5. Melting point -96.7 C (-142 F)
6. Vapor pressure at 20 C (68 F): 182 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F) Less than 0.1
8. Evaporation rate (butyl acetate = 1): 11.6

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers cause fires and explosions. Contact with strong acids will cause formation of flammable and toxic acetaldehyde gas.
3. Hazardous decomposition products: Toxic gases and vapors (such as vinyl chloride, hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving 1,1-dichloroethane

4. Special precautions: 1,1-Dichloroethane will attack some forms of plastics, rubber, and coatings

• Flammability

1. Flash point: -8.5 C (17 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Lower: 5.9; Upper: 15.9
4. Extinguishant: Foam, dry chemical, carbon dioxide

• Warning properties

The AIHA *Hygienic Guide* reports that 1,1-dichloroethane has a distinctive, easily recognizable odor at the TLV.

1,1-Dichloroethane is not known to be an eye irritant.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best made so that the average eight-hour exposure is based

on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure 1,1-dichloroethane may be used. An analytical method for 1,1-dichloroethane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 1,1-dichloroethane.

• Clothing wet with liquid 1,1-dichloroethane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 1,1-dichloroethane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 1,1-dichloroethane, the person performing the operation should be informed of 1,1-dichloroethane's hazardous properties.

• Any clothing which becomes wet with liquid 1,1-dichloroethane should be removed immediately and not

reworn until the 1,1-dichloroethane is removed from the clothing

- Employees should be provided with and required to use splash-proof safety goggles where liquid 1,1-dichloroethane may contact the eyes.

SANITATION

- Skin that becomes wet with liquid 1,1-dichloroethane should be immediately washed or showered with soap or mild detergent and water to remove any 1,1-dichloroethane.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,1-dichloroethane may occur and control methods which may be effective in each case:

Operation	Controls
Use as dewaxer of mineral oils; extractant for heat-sensitive substances	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a fumigant	General dilution ventilation of work area; personal protective equipment
Use in manufacture of vinyl chloride by vapor phase cracking; use in manufacture of high vacuum rubber and silicon grease; use as a chemical intermediate	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If 1,1-dichloroethane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If 1,1-dichloroethane gets on the skin, promptly flush the contaminated skin using soap or mild detergent and water. If 1,1-dichloroethane soaks through the clothing, remove the clothing immediately and flush the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of 1,1-dichloroethane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration.

Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When 1,1-dichloroethane has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If 1,1-dichloroethane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. 1,1-Dichloroethane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of 1,1-dichloroethane vapors are permitted.

• Waste disposal method:

1,1-Dichloroethane may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "1,1-Dichloroethane (Ethylidene Chloride)," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
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RESPIRATORY PROTECTION FOR 1,1-DICHLOROETHANE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s) Any supplied-air respirator. Any self-contained breathing apparatus
4000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode
Greater than 4000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors Any escape self-contained breathing apparatus

*Only NIOSH-approved or MSHA-approved equipment should be used.

1,1-DICHLOROETHYLENE^{1/}

Summary

1,1-Dichloroethylene caused kidney tumors (male mice only) and leukemia in one study of mice exposed by inhalation to 1,1-dichloroethylene. The results of other studies were equivocal or negative. 1,1-Dichloroethylene is mutagenic, and has caused adverse reproductive effects when administered to rats and rabbits by inhalation. Chronic exposure causes liver damage, and acute exposure to high doses produces nervous system damage.

CAS Number: 75-35-4

Chemical Formula: CH_2CCl_2

IUPAC Name: 1,1-Dichloroethene

Important Synonyms and Trade Names: Vinylidene chloride, VDC,
1,1-dichloroethene, 1,1-DCE

Chemical and Physical Properties

Molecular Weight: 96.94

Boiling Point: 37°C

Melting Point: -122.1°C

Specific Gravity: 1.218 at 20°C

Solubility in Water: 400 g/liter at 20°C

^{1/} U.S. Environmental Protection Agency, Office of Waste Program Enforcement. September 1985. Chemical, physical, and biological properties of compounds present at hazardous waste sites. A Final Report Prepared by Clement Associates, Inc., Arlington, Virginia.

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Solubility in Organics: Sparingly soluble in alcohol, ether, acetone, benzene, and chloroform

Log Octanol/Water Partition Coefficient (K_{ow}): 1.84 (Mabey et al. 1981) Estimated

Soil/Water Partition Coefficient (K_{oc}):

239	Lyman et al. (1982) Eqn 4-8 ($\log K_{ow} = 1.84$)
78	Lyman and Loreti (1987) ($\log K_{ow} = 1.84$)
65	USEPA (1986a)

Bioconcentration Factor:

20.2	Davies and Dobbs (1984) Eqn C ($\log K_{ow} = 2.18$)
26.7	Lyman et al. (1982) Eqn 5-2 ($\log K_{ow} = 2.18$)
30.9	Davies and Dobbs (1984) Eqn B ($\log K_{ow} = 2.18$)

Vapor Pressure: 500 mm Hg at 20°C
600 mm Hg at 25°C (USEPA 1986a)

Vapor Density: 3.25

Henry's Law Constant: 3.4×10^{-2} atm-m³/mole (USEPA 1986a)

Transport and Fate

Volatilization is likely to be the primary transport process for 1,1-dichloroethylene (VDC), and its subsequent photooxidation in the atmosphere by reaction with hydroxyl radicals is the predominant fate process. The half-life of 1,1-dichloroethylene in water is estimated to be between one and six days (USEPA 1984).

A range of estimated soil-water partition coefficients (K_{oc}) is reported above and indicates that sorption of 1,1-dichloroethylene to soils/sediments and dissolved organic material will occur. Pavlou (1980) estimates that sorption of volatile organic compounds will range

from low to moderate. The combined water solubility and low organic partitioning of 1,1-dichloroethylene suggests that this compound will exhibit some degree of environmental mobility.

A range of estimated bioconcentration factor (BCFs) for 1,1-dichloroethylene is also reported above. ASTM (1985) indicates that chemicals with bioconcentration factors less than approximately 100 have low potential for causing harm to wildlife and human health via biomagnification of residues up food chains. The magnitude of the concentration factors suggests that appreciable bioconcentration or biomagnification of 1,1-dichloroethylene residues is not likely to occur.

Health Effects

1,1-Dichloroethylene caused kidney tumors in male mice and leukemia in both males and females when exposed by inhalation. Equivocal results were obtained in other inhalation studies. Negative results were obtained in cancer studies with rats and mice following oral exposure or in hamsters following inhalation exposure. 1,1-Dichloroethylene has been classified according to EPA's Proposed Guidelines for Carcinogen Risk Assessment in EPA's Group C (possible human carcinogen) based on limited evidence in animals and inadequate evidence in humans (USEPA 1985).

1,1-Dichloroethylene was mutagenic in several bacterial assays. 1,1-Dichloroethylene did not appear to be teratogenic but did cause embryotoxicity and fetotoxicity when administered to pregnant rats and rabbits by inhalation. Chronic exposure to oral doses of 1,1-dichloroethylene as low as 5 mg/kg/day caused liver changes in rats. Acute exposure to high doses causes central nervous system depression. Neurotoxicity has not been associated with low-level chronic exposure. The oral LC_{50} value for rats and mice are 1,500 and 200 mg/kg, respectively.

Toxicity to Wildlife and Domestic Animals

1,1-Dichloroethylene is not very toxic to freshwater or saltwater species, with acute LC_{50} values generally ranging from 80 to 200 mg/liter (USEPA 1980). A chronic study in which no adverse effects were observed indicated that the acute-chronic ratio was less than 40. A 13-day study reporting an LC_{50} of 29 mg/liter indicated that the acute-chronic ratio for 1,1-dichloroethylene is greater than 4.

No reports of the toxicity of 1,1-dichloroethylene to terrestrial wildlife or domestic animals were found in the literature reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA 1986b).

Aquatic Life (Freshwater)

The available data are not adequate for establishing criteria. However, EPA does report the lowest values known to cause toxicity in aquatic organisms.

Acute toxicity: 11,600 μ g/liter

Chronic toxicity: No available data

Aquatic Life (Saltwater)

Acute toxicity: 224,000 μ g/liter

Chronic toxicity: No available data

Human Health

Due to the carcinogenicity of 1,1-dichloroethylene the ambient water criterion is set at zero. However, estimates of the carcinogenic risks associated with lifetime exposure from ingestion of contaminated water and contaminated aquatic organisms are:

<u>Risk</u>	<u>Concentration</u>
10^{-5}	0.33 $\mu\text{g/liter}$
10^{-6}	0.033 $\mu\text{g/liter}$
10^{-7}	0.0033 $\mu\text{g/liter}$

National Primary Drinking Water Standard (USEPA): 0.007 mg/liter
(40 CFR Part 141)

CAG Potency Slope for Inhalation Exposure (USEPA 1989) = 1.2
(mg/kg/day) $^{-1}$

CAG Potency Slope for Oral Exposure (USEPA 1989) = 0.6 (mg/kg/day) $^{-1}$

D_T Value

The D_T value is defined as that contaminant intake rate (mg/kg/day) that should not induce an adverse effect to human health or should not pose a risk of cancer occurrence greater than a predetermined risk level.

For oral and inhalation exposures to 1,1-dichloroethylene, the D_T value is based on the USEPA Cancer Assessment Group's cancer potency slopes. The cancer potency slopes are intended to be a plausible upper bound of the potency of a carcinogen in inducing cancer at low doses. Calculation of a D_T using a cancer potency slope requires selection of an acceptable cancer risk level. A range of risk levels from 10^{-4}

to 10^{-7} will be considered for all carcinogens, therefore a range of D_T values is presented. Derivation of the inhalation D_T value for 1,1-dichloroethylene is as follows:

$$\begin{aligned}
 D_T &= \frac{\text{Risk Level}}{\text{Potency Slope (mg/kg/day)}^{-1}} \\
 &= \frac{1 \times 10^{-4}}{1.16 \text{ (mg/kg/day)}^{-1}} \\
 &= 8.6 \times 10^{-5} \text{ mg/kg/day}
 \end{aligned}$$

For oral exposure to 1,1-dichloroethylene, the D_T value is also based on the USEPA Cancer Assessment Group's cancer potency estimate. Derivation of the oral D_T value is as follows:

$$\begin{aligned}
 D_T &= \frac{\text{Risk Level}}{\text{Potency Slope (mg/kg/day)}^{-1}} \\
 &= \frac{1 \times 10^{-4}}{0.6 \text{ (mg/kg/day)}^{-1}} \\
 &= 1.7 \times 10^{-4} \text{ mg/kg/day}
 \end{aligned}$$

The range of inhalation and oral D_T values for 1,1-dichloroethylene is presented below.

<u>Risk Level</u>	<u>Oral D_T (mg/kg/day)</u>	<u>Inhalation D_T (mg/kg/day)</u>
10^{-4}	1.7×10^{-4}	8.3×10^{-5}
10^{-5}	1.7×10^{-5}	8.3×10^{-6}
10^{-6}	1.7×10^{-6}	8.3×10^{-7}
10^{-7}	1.7×10^{-7}	8.3×10^{-8}

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TLV 5 mg/m³ (See Sect II)

FIRST AID.

Ingestion. Contact physician. Stomach lavage may be needed.

Contain spill and pick up with absorbent solid, rags, or paper for disposal by burning. Prevent losses into the environment whenever possible. Do not send to sewer. (DEHP degrades in fresh water sediments under aerobic conditions, half life about 14 days. It does not degrade under anaerobic conditions. It is readily concentrated by aquatic organisms.) Clean up trace residues with water and detergent

DISPOSAL: Scrap material can be disposed of by controlled incineration Mix liquid scrap with a more flammable solvent and spray into incinerator's firebox. Follow Federal, State, and Local regulations.

Use general ventilation, combined with local exhaust ventilation (especially when material is heated or misted) to meet the TLV requirements. For nonroutine and emergency conditions where the TLV is exceeded, use an approved air-supplied mask or organic canister respirator for protection against mist and vapors.

Use rubber gloves and apron to avoid repeated or prolonged contact with liquid and safety glasses or goggles to avoid eye contact by splashing. Depending on how the material is used and conditions of use, additional body protection may be desirable.

Eyewash fountain and safety showers should be available to areas of use and handling.

UEDP contaminated clothing should be removed and laundered before reuse.

Store in a ventilated area away from oxidizing agents and sources of heat or ignition. Follow good hygienic practice to avoid chronic effects. Wear clean work clothing. Avoid prolonged or repeated contact with liquid and inhalation of mist or vapors. Do not eat or smoke in areas where this material is used or stored. Wash exposed skin areas after working with this material and before using restroom facilities, eating or smoking. Do not take internally.

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MEDICAL REVIEW December 1984

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DIPHENYLNITROSAMINE

CAS RN: 86306

NIOSH # JJ 9800000

mf: $C_{12}H_{10}N_2O$, mw: 198.24

Green crystals. mp: 144°.

SYNS:

DIPHENYLNITROSAMIN (GER-
MAN)
NCI-C02880

N-NITROSODIPHENYLAMIN
(CZECH)
N-NITROSODIPHENYLAMINE

TOXICITY DATA: 3

eye-rbt 500 mg/24H SEV
mma-mus:lym 100 mg/L/4H
cyt-ham: fbr 30 mg/L/48H
sce-ham: fbr 100 umol/L
ori-rat TDLo: 140 gm/kg/2Y-C-CAR

skn-mus TDLo: 800 mg/kg/20W-
I:ETA

ori-rat TD: 170 gm/kg/2Y-C CAR

ori-rat LD50: 1650 mg/kg
ori-mus LD50: 3850 mg/kg

CODEN:

28ZPAK -,134,72
MUREAV 59,61,79
MUREAV 48,337,77
JNCIAM 58,1635,77
NCITR* NCI-CG-TR-
164,79

EJCAAH 16,695,80

NCITR* NCI-CG-TR-
164,79

28ZPAK -,134,72
GTPZAB 10,60,66

NCI Carcinogenesis Bioassay Completed; Results Positive: Rat (NCITR* NCI-CG-TR-164,79); Negative: Mouse (NCITR* NCI-CG-TR-164,79). Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MUT data. An eye irr. An exper CARC, ETA. MOD ori.

Fire Hazard: Dangerous, when exposed to heat or flame or by chemical reaction.

Disaster Hazard: Dangerous; when heated to decomp it emits highly tox fumes of NO_x ; can react vigorously with oxidizing materials.

Occupational Health Guideline for Tetrachloroethylene*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CCl}_2 = \text{CCl}_2$
- Synonyms Perchloroethylene; perchlorethylene; tetrachlorethylene; perk
- Appearance and odor. Colorless liquid with an odor like chloroform or ether.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tetrachloroethylene is 100 parts of tetrachloroethylene per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 200 ppm and a maximum acceptable peak of 300 ppm for 5 minutes in any three-hour period. NIOSH has recommended that the permissible exposure limit be reduced to 50 ppm (339 mg/m^3) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 100 ppm (678 mg/m^3) averaged over a 15-minute period. The NIOSH Criteria Document for Tetrachloroethylene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Tetrachloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Tetrachloroethylene may cause headache, nausea, drowsiness, dizziness, incoordination, and unconsciousness. It may also cause irritation of

the eyes, nose, and throat and flushing of the face and neck. In addition, it might cause liver damage with such findings as yellow jaundice and dark urine. The liver damage may become evident several weeks after the exposure.

2. Long-term Exposure: Prolonged or repeated overexposure to liquid tetrachloroethylene may cause irritation of the skin. It might also cause damage to the liver and kidneys.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tetrachloroethylene.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to tetrachloroethylene at potentially hazardous levels

1. Initial Medical Examination:

—A complete history and physical examination. The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver and the cardiovascular and neurological systems should be stressed. The skin should be examined for evidence of chronic disorders.

—Liver function tests: Tetrachloroethylene may cause liver damage. A profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Tetrachloroethylene vapor is a narcotic. Rats did not survive when exposed for longer than 12-18 minutes to 12,000 ppm; when exposed repeatedly to 470 ppm they showed liver and kidney injury. Cardiac arrhythmias

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

attributed to sensitization of the myocardium to epinephrine have been observed with certain other chlorinated hydrocarbons, but exposure of dogs to concentrations of 5000 and 10,000 ppm tetrachloroethylene did not produce this phenomenon. Four human subjects were unable to tolerate 5000 ppm in a chamber for 6 minutes. They experienced vertigo, nausea, and mental confusion during the 10 minutes following cessation of exposure. In an industrial exposure to an average concentration of 275 ppm for 3 hours, followed by 1100 ppm for 30 minutes, a worker lost consciousness; there was apparent clinical recovery 1 hour after exposure but the monitored concentration of tetrachloroethylene in the patient's expired air diminished slowly over a 2-week period. Long-term industrial exposures have been reported to cause various neuropathies, such as numbness, trembling, neuritis, and defects of memory. During the second and third post-exposure weeks, the results of liver function tests became abnormal, suggesting that acute exposure had had a significant effect upon the liver. Other instances of liver injury following industrial exposure have been reported. Other effects on humans of inhalation of various concentrations are as follows: 2000 ppm, mild narcosis within 5 minutes; 600 ppm, sensation of numbness around the mouth, dizziness, and some incoordination after 10 minutes. In human experiments, 7-hour exposures at 100 ppm resulted in mild irritation of the eyes, nose, and throat; flushing of the face and neck; headache; somnolence; slurred speech. Exposure of the skin to the liquid for 15 minutes resulted in a progressively severe burn—irritation beginning within 5 to 10 minutes; the result was marked erythema, which subsided after 1 to 2 hours. The liquid sprayed into rabbits' eyes produced immediate pain and blepharospasm; patches of epithelium were lost, but the eyes recovered completely within 2 days.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 165.85
2. Boiling point (760 mm Hg): 121.2 C (250 F)
3. Specific gravity (water = 1): 1.62
4. Vapor density (air = 1 at boiling point of tetrachloroethylene): 5.83
5. Melting point: -22.4 C (-8 F)
6. Vapor pressure at 20 C (68 F): 14 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.015
8. Evaporation rate (butyl acetate = 1): 2.8

• Reactivity

1. Conditions contributing to instability: Heat.
2. Incompatibilities. Tetrachloroethylene reacts with strong oxidizers and chemically active metals such as calcium, lithium, and beryllium.

• Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released when tetrachloro-

ethylene decomposes.

4. Special precautions. Liquid tetrachloroethylene will attack some forms of plastics, rubber, and coatings

• Flammability

1. Not combustible

• Warning properties

1. Odor Threshold Both May and Stern state that 50 ppm is the odor threshold for tetrachloroethylene.

2. Eye Irritation Level Grant reports that "exposure to high concentrations of (tetrachloroethylene) vapor causes mild sensation of irritation to the eyes, but serious injury is not likely." The exact concentrations producing irritation are not mentioned by Grant.

Spector, however, reports that after a 20- to 30-minute exposure to 206 to 235 ppm, eye irritation occurs in humans.

Patty reports "very slight irritation of the eyes" among humans at 106 ppm.

3. Other Information: Spector reports that a 10-minute exposure to 513 to 690 ppm produces nose and throat irritation.

4. Evaluation of Warning Properties: Since the odor threshold of tetrachloroethylene is below the permissible exposure limit, and since eye irritation occurs at a concentration only twice the permissible exposure limit, its warning properties are considered to be adequate

MONITORING AND MEASUREMENT PROCEDURES

• Eight-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of tetrachloroethylene. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Peak Above Ceiling Evaluation

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of tetrachloroethylene. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of

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three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure

- **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure tetrachloroethylene may be used. An analytical method for tetrachloroethylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid tetrachloroethylene.

- Non-impervious clothing which becomes contaminated with liquid tetrachloroethylene should be removed promptly and not reworn until the tetrachloroethylene is removed from the clothing.

- Clothing wet with liquid tetrachloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetrachloroethylene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetrachloroethylene, the person performing the operation should be informed of tetrachloroethylene's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where liquid tetrachloroethylene may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid tetrachloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any tetrachloroethylene.

- Employees who handle liquid tetrachloroethylene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tetrachloroethylene may occur and control methods which may be effective in each case:

Operation	Controls
Use as dry cleaning solvent; as degreasing and metal cleaning agent; in vapor degreasing of metal parts	Local exhaust ventilation, general dilution, personal protective equipment
Use as chemical intermediate in production of fluorocarbons, pesticides, and trichloroacetic acid	Process enclosure; local exhaust ventilation, general dilution ventilation
Use as scouring, sizing, desizing, solvent and greaser remover in processing and finishing of textiles	Local exhaust ventilation; general dilution; personal protective equipment
Use as general industrial solvent in rubber, textile, printing, soap, and paint remover industries	Local exhaust ventilation; general dilution; personal protective equipment
Use as extraction agent for vegetable and mineral oils and in pharmaceutical industry; as vermifuge, as laundry treatment for presoaking and as drying medium in metal and wood industries	Local exhaust ventilation; general dilution ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Exposure

If tetrachloroethylene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If tetrachloroethylene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If tetrachloroethylene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of tetrachloroethylene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When tetrachloroethylene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If tetrachloroethylene is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

Waste disposal method

Tetrachloroethylene may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

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• SPECIAL NOTE

Tetrachloroethylene appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol. 45, No 157, pp. 5372-5379, 12 August 1980) The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*. Volume 20, 1979

RESPIRATORY PROTECTION FOR TETRACHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 312

TRICHLOROETHYLENE

(Revision E)

Issued: July 1979

Revised August 1987

SECTION 1. MATERIAL IDENTIFICATION

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MATERIAL NAME TRICHLOROETHYLENE

DESCRIPTION (Origin/Uses) Prepared from sym-tetrachloroethane by way of eliminating HCl by boiling with lime. Used to manufacture organic chemicals, pharmaceuticals; in degreasing and dry cleaning, and as a solvent for fats, waxes, rubbers, oils, paints, varnishes, ethers, and cellulose esters.

OTHER DESIGNATIONS Ethylene Trichloride; TCE, Trichloroethane; 1,1,2-Trichloroethylene;

C_2HCl_3 ; NIOSH RTECS #KX4550000; CAS #0079-01-6

MANUFACTURER/SUPPLIER Available from several suppliers, including:

Dow Chemical USA, 2020 Dow Center, Midland, MI 48640;

Telephone: (517) 636-1000; (800) 258-CHEM

COMMENTS Trichloroethylene is a toxic solvent and a suspected occupational carcinogen.

HMIS

H 2

F 1

R 1

PPE*

* See sect. 8

R 1

I 3

S 1

K 0

SECTION 2. INGREDIENTS AND HAZARDS

Trichloroethylene, CAS #0079-01-6, NIOSH RTECS #KX4550000

%

100

HAZARD DATA

ACGIH Values 1987-88

TLV-TWA* 50 ppm, 270 mg/m³

TLV-STEL** 200 ppm, 1080 mg/m³

OSHA PEL 1986***

8-Hr TWA* 100 ppm

Ceiling 200 ppm

NIOSH REL 1986

10-Hr TWA 25 ppm

TOXICITY DATA

Human, Oral, LD₅₀ 7 g/kg

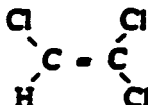
Human, Inhalation, TC_{Lo} 6900 mg/m³

(10 Min)

Human, Inhalation, TC_{Lo} 160 ppm/

83 Min

Human, Inhalation, TD_{Lo} 812 mg/kg



- * The TLV-TWA is set to control subjective complaints such as headache, fatigue, and irritability.
- ** The TLV-STEL is set to prevent incoordination and other beginning anesthetic effects from TCE. These levels should provide a wide margin of safety in preventing liver injury
- *** The OSHA PEL is 300 ppm for 5 minutes in any 2 hours.

SECTION 3. PHYSICAL DATA

Boiling Point ... 188.6°F (87°C)

Pressure ... 58 Torr at 68°F (20°C)

Solubility ... Insoluble

Vapor Density (Air = 1) ... 4.53

Evaporation Rate ... Not Listed

Specific Gravity ... 1.4649 at 68°F (20°C)

Melting Point ... -120.64°F (-84.8°C)

Molecular Weight ... 131.40 Grams/Mole

Appearance and odor Colorless, nonflammable mobile liquid; sweetish odor like chloroform.

COMMENTS: TCE is highly soluble in lipids. A high vapor pressure at room temperature provides the potential for TCE vapors to contaminate use areas.

SECTION 4. FIRE AND EXPLOSION DATA

LOWER

UPPER

Flash Point and Method

Autoignition Temperature

Flammability Limits in Air

Not Listed

770°F (410°C)

% by Volume

8%

10.5%

EXTINGUISHING MEDIA. TCE has no flash point in a conventional closed tester at room temperature, but it is moderately flammable at higher temperatures. Use dry chemical, carbon dioxide, alcohol foam, or other extinguishing agents suitable for the surrounding fire.

OSHA Flammability Class (29 CFR 1910.106): Not Regulated

UNUSUAL FIRE/EXPLOSION HAZARDS: During fire conditions TCE emits highly toxic and irritating fumes, including hydrochloric acid and phosgene. **SPECIAL FIRE-FIGHTING PROCEDURES:** Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode. At TCE vapor levels of 300-1000 ppm, fire fighters who lack the proper respiratory equipment may experience incoordination and impaired judgment.

DOT Flammability Class (49 CFR 173.115): Not Regulated

SECTION 5. REACTIVITY DATA

Trichloroethylene is stable. Hazardous polymerization can occur under certain circumstances (see Conditions to Avoid and Comments, below).

CHEMICAL INCOMPATIBILITIES include magnesium or aluminum powder, NaOH, KOH, or other strong alkaline materials.

Reactions with alkaline materials may lead to the formation of dangerous explosive mixtures of chloroacetylenes.

CONDITIONS TO AVOID: When TCE is heated (as in the case with vapor degreasers) or exposed to sunlight, it requires extra

caution against oxidation, degradation, and polymerization. It is slowly decomposed by light when moist.

DUCTS OF HAZARDOUS DECOMPOSITION include hydrochloric acid and phosgene under certain conditions at elevated temperatures.

COMMENTS TCE is stable under normal handling and storage conditions, and hazardous polymerization is not expected to occur. However, failure of the stabilizer at elevated temperatures or other extreme conditions may allow polymerization to take place.

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SECTION 6. HEALTH HAZARD INFORMATION

Trichloroethylene is listed as a carcinogen by the NTP, IARC, and OSHA. NIOSH recommends that trichloroethylene be treated as an occupational carcinogen. IARC carcinogenic results are animal suspect, animal positive, and human indefinite. **SUMMARY OF RISKS** Moderate exposures to TCE cause symptoms similar to those of alcohol intoxication. Higher concentrations cause narcotic effects. Ventricular fibrillation has been cited as the cause of death following heavy exposures. TCE-induced hepatic cellular carcinomas have been detected in mice during tests conducted by the National Cancer Institute (Chem & Eng News 54 [April 5, 1976]:4). Organ systems affected by overexposure to TCE are the central nervous system (euphoria, analgesia, anesthesia), degeneration of the liver and kidneys, the lungs (tachypnea), heart (arrhythmia) and skin (irritation, vesication, and paralysis of fingers when immersed in liquid TCE). Contact with the liquid defects the skin, causing topical dermatitis. Certain people appear to experience synergistic effects from TCE exposure concomitant with exposure to caffeine, alcohol, and other drugs. When combined with alcohol intake, toxic effects are increased and may cause a red, blotchy facial and upper body rash commonly called "degreaser's flush." Other reported symptoms of TCE exposure include abnormal fatigue, headache, irritability, gastric disturbances, and intolerance to alcohol. Toxic effects from testing of TCE on humans include hallucination, distorted perception, somnolence (general depressed activity), and jaundice. **TARGET ORGANS:** Respiratory system, central nervous system, heart, liver, kidneys, and skin. **PRIMARY ENTRY:** Inhalation, absorption, skin contact. **ACUTE EFFECTS:** Headache, vertigo, visual disturbance, tremors, nausea, vomiting, dermatitis, dizziness, drowsiness, and irritation to the eyes, nose, and throat. **CHRONIC EFFECTS:** None Reported. **MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE:** Diseases of the liver, kidneys, lungs, and central nervous system. **FIRST AID EYE CONTACT:** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help. **SKIN CONTACT:** Wash thoroughly with soap and water. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment. Get medical help. **INHALATION:** Remove victim to fresh air; restore and/or support his breathing as needed. Do not give artificial respiration to the victim. Get medical help. **INGESTION:** Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. A professional decision regarding whether or not to induce vomiting is required. Do not give artificial respiration to the victim. Get medical help. **GET MEDICAL ASSISTANCE - IN PLANT, PARAMEDIC, COMMUNITY:** Get prompt medical assistance for further treatment, observation, and support after first aid.

COMMENTS: Workers' responses to TCE vary significantly because of many factors, including age, health status, nutrition, and intake of alcohol, caffeine, and medicines. Do not use these substances before, during, or after exposure to TCE. If a worker displays any of the symptoms of exposure to TCE, thoroughly investigate all the possible contributing factors to determine, if possible, how much the work environment levels of TCE are responsible.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Inform safety personnel of any trichloroethylene spill or leak and evacuate the area for large spills. Cleanup personnel must use respiratory and liquid contact protection. Adequate ventilation must be provided. Confine the spilled TCE to as small an area as possible. Do not allow it to run off to sewers or open waterways. Pick up spilled TCE with a vacuum cleaner or an absorbent such as vermiculite.

DISPOSAL: Consider reclamation, recycling, or destruction rather than disposal in a landfill.

Trichloroethylene is designated as a hazardous substance by the EPA (40 CFR 116.4).

Trichloroethylene is reported in the 1983 EPA TSCA Inventory.

EPA Hazardous Waste Number (40 CFR 261.33): U228

EPA Reportable Quantity (40 CFR 117.3): 1000 lbs (454 kgs)

Aquatic Toxicity Rating, TLM 96 Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Always wear protective eyeglasses or chemical safety goggles. Follow the eye and face protection guidelines of 29 CFR 1910.133. **GLOVES:** Wear impervious gloves. **RESPIRATOR:** Use a NIOSH-approved respirator per the NIOSH Guide to Chemical Hazards (Genium ref 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. Any detectable concentration of TCE requires an SCBA, full facepiece, and pressure-demand/positive-pressure modes. **WARNING:** Air-purifying respirators will not protect workers from oxygen-deficient atmospheres. **OTHER EQUIPMENT:** Wear rubber boots, aprons, and other suitable body protection appropriate to the existing work environment. **VENTILATION:** Install and operate general and local exhaust ventilation systems of sufficient power to maintain airborne concentrations of TCE below the OSHA PEL standards cited in section 2. **SAFETY STATIONS:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. **OTHER SPECIAL MODIFICATIONS IN THE WORKPLACE:** Because of the unresolved controversy about the carcinogenic status of TCE, all existing personal protective equipment and engineering technology should be used to prevent any possibility of worker contact with this material.

COMMENTS: Practice good personal hygiene. Keep material off of your clothes and equipment. Avoid transfer of material from hands to mouth while eating, drinking, or smoking. Adhere to the sanitation requirements of 29 CFR 1910.141 and 29 CFR 1910.142.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Prevent TCE from coming into contact with strong caustics such as NaOH, KOH; chemically active metal like Ba, Li, Na, Mg, Ti; and powdered aluminum or magnesium in acidic solutions. **SPECIAL HANDLING/STORAGE:** Store this material in a cool, dry, well-ventilated area. Avoid elevated temperatures because products of toxic and corrosive decomposition from TCE may form. Monitor the level of any stabilizer component that may be added to the TCE. (Consult the technical data from the supplier to determine the specifics of any added stabilizer.) If applicable, follow the supplier's recommendation concerning proper rotation of stock, shelf-life requirements, and levels of stabilizers.

ENGINEERING CONTROLS IN THE WORKPLACE: Avoid collecting aluminum fines (very small particles) or chips in a TCE vapor degreaser. Monitor TCE stabilizer levels regularly. Only trained personnel should operate vapor degreasers.

TRANSPORTATION DATA (per 49 CFR 172.101-2):

DOT Hazard Class ORM-A

DOT ID No. UN1710

IMO Class: 6.1

IMO Label: St. Andrew's Cross (X)*

DOT Shipping Name: Trichloroethylene

DOT Label: None

* Harmful - Slow away from foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III)

References 1-9, 12, 14, 21, 73, 87-94 PI

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H.A.B.

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OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR VINYL CHLORIDE POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

This guideline summarizes pertinent information about vinyl chloride for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

- Formula: C_2H_3Cl
- Structure: $CH_2=CHCl$
- Synonyms: Chloroethene, chloroethylene, monochloroethylene, chloroethylene
- Identifiers: CAS 75-01-4; RTECS KU9625000; DOT 1086, label required. "Flammable Gas"
- Appearance and odor: Colorless gas with a sweet odor

CHEMICAL AND PHYSICAL PROPERTIES

- Physical data
 1. Molecular weight: 62.50
 2. Boiling point (at 760 mmHg): $-14^{\circ}C$ ($7^{\circ}F$)
 3. Specific gravity (water = 1): 0.9121
 4. Vapor density (air = 1 at boiling point of vinyl chloride): 2.15
 5. Melting point: $-155.7^{\circ}C$ ($-243.4^{\circ}F$)
 6. Vapor pressure at $20^{\circ}C$ ($68^{\circ}F$): 2,580 mmHg
 7. Solubility in water, g/100 g water at $24^{\circ}C$ ($75^{\circ}F$): 0.11
 8. Ionization potential: 9.995 eV
- Reactivity
 1. Incompatibilities Atmospheric oxygen and strong oxidizers may react with vinyl chloride to produce peroxide, which can initiate a violent polymerization reaction.

2. Hazardous decomposition products. Toxic vapors and gases (e.g., hydrogen chloride and carbon monoxide) may be released in a fire involving vinyl chloride.

3. Caution: Check valves for leaks.

• Flammability

1. Flash point: $-78^{\circ}C$ ($-108^{\circ}F$) (open cup)
2. Autoignition temperature: $472^{\circ}C$ ($882^{\circ}F$)
3. Flammable limits in air, % by volume: Lower, 3.6, Upper, 33.0
4. Class 1A Flammable Liquid Gas (29 CFR 1910.106), Flammability Rating 4 (NFPA)

• Warning properties

1. Odor threshold 3,000 ppm
2. Evaluation of warning properties for respirator selection. Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for vinyl chloride is 1 part of vinyl chloride per million parts of air (ppm) as a time-weighted average (TWA) concentration over an 8-hour workshift, and the ceiling concentration which shall at no time be exceeded is 5 ppm as determined in any 15-minute sampling period. The National Institute for Occupational Safety and Health (NIOSH) recommends that vinyl chloride be controlled and handled as a potential human carcinogen in the workplace, and the NIOSH recommended exposure limit (REL) is that exposure be minimized to the lowest feasible limit. The American Conference of Governmental Industrial Hygienists (ACGIH) has designated vinyl chloride as an A1 substance (suspected human carcinogen) with an assigned threshold limit value, TLV® of 5 ppm [10 milligrams of vinyl chloride per cubic meter of air (mg/m^3)] as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

Table 1.—Occupational exposure limits for vinyl chloride

	Exposure limits	
	ppm	mg/m ³
OSHA PEL TWA	1	—
Ceiling (15 min)	5	—
NIOSH REL (Ca)*	Lowest feasible limit	
ACGIH TLV® TWA (Ala)†	5	10

* (Ca). NIOSH recommends treating as a potential human carcinogen.

† (Ala). Human carcinogen with an assigned TLV.

HEALTH HAZARD INFORMATION

• Routes of exposure

Vinyl chloride may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

• Summary of toxicology

1 *Effects on animals* Acute inhalation of vinyl chloride by multiple species of animals caused central nervous system depression, coma, and death, acute inhalation by dogs also caused cardiac arrhythmias. In mice, rats, and hamsters, chronic inhalation or oral administration of vinyl chloride produced cancers of the liver, kidney, central nervous system, skin, and mammary and ear duct glands.

2. *Effects on humans* Acute exposure of workers to vinyl chloride has caused narcotic and anesthetic effects. Repeated exposure of workers to vinyl chloride has caused increased blood pressure, decreased blood platelet counts, increased liver enzyme levels, restricted blood flow, bone degeneration in the fingers, liver and spleen enlargement, nervous system disturbances, central nervous system depression, decreased respiratory function, and emphysema. Cancer of the liver has been associated with exposure of workers to vinyl chloride during the polyvinyl chloride production process. Cancers of the lung, brain, skin, nervous system, gall bladder, mouth, and pharynx have also been observed in workers with a history of exposure to vinyl chloride. An increase in fetal mortality has been reported among wives of workers who had been exposed to vinyl chloride.

• Signs and symptoms of exposure

1. *Short-term (acute)* Exposure to vinyl chloride can cause dizziness, light-headedness, nausea, dullness of visual and auditory responses, drowsiness, and unconsciousness. Irritation of the skin and eyes can also occur. Skin contact with the liquid can cause frostbite.

2. *Long-term (chronic)* Exposure to vinyl chloride can cause thickening of the skin, contact and allergic dermatitis, fatigue, coughing and sneezing, abdominal pain, gastrointestinal bleeding, nausea, vomiting, indigestion, diarrhea, jaundice, weight loss, anorexia, and a cold and tingling sensation of the hands and feet.

RECOMMENDED MEDICAL PRACTICES

• Medical surveillance program

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including the employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

• Preplacement medical evaluation

Prior to placing a worker in a job with a potential for exposure to vinyl chloride, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the skin, liver, kidneys, and cardiovascular, hematopoietic (blood cell forming), nervous, and respiratory systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to vinyl chloride. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include chronic diseases of the liver. The physician should obtain baseline values for serological tests of liver function and markers for infection with Hepatitis B virus.

• Periodic medical screening and/or biologic monitoring
Occupational health interviews and physical examinations

should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to vinyl chloride. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the integrity and physiologic function of the skin, liver, kidneys, and cardiovascular, hematopoietic, nervous, and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population. The following test should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and ATS: standardized questionnaires and test of lung function.

• **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to vinyl chloride may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

• **Sentinel health events**

Delayed-onset SHE's include: Liver cancer (hemangiosarcoma) and "white finger" (Raynaud's syndrome, secondary to vasculitis)

MONITORING AND MEASUREMENT PROCEDURES

• **Method**

Sampling and analysis may be performed by collecting vinyl chloride vapors with tandem charcoal tubes followed by desorption with carbon disulfide and analysis by gas chromatography. Direct-reading devices calibrated to measure vinyl chloride may also be used if available. A detailed sampling and analytical method for vinyl chloride may be found in the *NIOSH Manual of Analytical Methods* (method number 1007).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with vinyl chloride.

SANITATION

Clothing which is contaminated with vinyl chloride should be removed immediately and placed in sealed containers for

storage until it can be discarded or until provision is made for the removal of vinyl chloride from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of vinyl chloride's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with vinyl chloride should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle vinyl chloride should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to vinyl chloride may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for vinyl chloride

Operations	Controls
During the manufacture of monomer, polymer, copolymer, and terpolymer	Process enclosure, personal protective equipment
During the transfer of monomer to tank cars or polymerization reactors; during maintenance work on tanks or reactors	Local exhaust ventilation, personal protective equipment
During the cleaning of polymerization reaction tanks	Process enclosure, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures:

• **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to vinyl chloride, an eye-wash fountain should be

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provided within the immediate work area for emergency use.

If vinyl chloride gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

- **Skin exposure**

Where there is any possibility of a worker's body being exposed to vinyl chloride, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If vinyl chloride gets on the skin, wash it immediately with soap and water. If vinyl chloride penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

- **Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. Put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

If vinyl chloride is spilled or leaked, the following steps should be taken:

- 1 Stop the flow of gas. If the source of the leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to an area with local exhaust ventilation and repair the leak or allow the cylinder to empty.
- 2 Remove all ignition sources.
- 3 Ventilate area of spill or leak.

WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations including those requiring confined-space entry (Table 3).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.

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Table 3.—Respiratory protection for vinyl chloride

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern Any appropriate escape-type self-contained breathing apparatus

* Only NIOSH/MSHA-approved equipment should be used.

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ATTACHMENT D

**W-C STANDARD OPERATING PROCEDURES
FOR HEALTH AND SAFETY**

OPERATING PROCEDURES NO. HS-102

102.0 HEAT STRESS

102.1 PURPOSE

The purpose of this OP is to provide general information on heat stress and the methods that can be utilized to prevent or minimize the occurrence of heat stress.

Adverse climatic conditions are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability. Heat stress is of particular concern while wearing impermeable protective garments, since these garments inhibit evaporative body cooling.

102.2 REQUIREMENTS

The NIOSH criteria document for heat stress recommends that environmental monitoring and other preventive measures be adopted in hot work environments. However, the provisions are not directly applicable to employees who are required to wear impermeable protective clothing. The reason for this exception is that impermeable clothing prevents the evaporation of sweat, which is one of the most important cooling mechanisms of the body. There is no recognized health standard protection for workers wearing impermeable protective clothing and respirators in hot environments.

The ACGIH has adopted a TLV for heat stress. These guides relate to work/rest regimes.

102.3 ADDITIONAL HAZARD

The use of Personal Protective Equipment of the types commonly used for hazardous waste work can place stress on the body. One common problem with the use of personal protective equipment, especially in hot environments, is heat stress. Protective clothing can cause excessive sweating and can prevent the body from properly regulating body temperature.

102.4 TYPES OF HEAT STRESS

Heat stress is the aggregate of environmental and physical work factors that constitute the total heat load imposed on the body. The environmental factors of heat stress are the air temperature, radiant heat exchange, air movement, and water vapor pressure. Physical work contributes to the total heat stress of the job by producing metabolic heat in the body in proportion to the intensity of the work. The amount and type of clothing also affect the heat stress.

Heat strain is the series of physiological responses to heat stress. When the strain is excessive for the exposed individual, a feeling of discomfort or distress may result, and, finally, a heat disorder may ensue. The severity of strain will depend not only on the magnitude of the prevailing stress, but also on the age, physical fitness, degree of acclimatization, and dehydration of the worker.

Heat disorder is a general term used to describe one or more of the following heat-related disabilities or illnesses:

- o Heat Cramps - painful intermittent spasms of the voluntary muscles following hard physical work in a hot

environment. Cramps usually occur after heavy sweating, and often begin at the end of a work shift.

- o Heat Exhaustion - profuse sweating, weakness, rapid pulse, dizziness, nausea, and headache. The skin is cool and sometimes pale and clammy with sweat. Body temperature is normal or subnormal. Nausea, vomiting, and unconsciousness may occur.
- o Heat Stroke - sweating is diminished or absent. The skin is hot, dry, and flushed. Increased body temperature, which, if uncontrolled, may lead to delirium, convulsions, coma, and even death. Medical care is urgently needed.

102.5 METHODS OF CONTROLLING HEAT STRESS

As many of the following control measures as are appropriate to site conditions should be utilized to aid in controlling heat stress:

- o Provide for adequate liquids to replace lost body fluids and replace water and salt lost from sweating. Encourage personnel to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.
- o Replace fluids with water, commercial mixes such as Gatorade or Quick Kick, or a combination of these.
- o Establish a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts of workers.

- o Wear cooling devices such as vortex tubes or cooling vests beneath protective garments.
- o Take all breaks in a cool rest area (77°F is best).
- o Remove impermeable protective garments during rest periods.
- o Do not assign other tasks to personnel during rest periods.
- o Inform personnel of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

102.6 MONITORING

102.6.1 TEMPERATURE

The heat stress of an area can be monitored by the Wet Bulb Globe Temperature Index (WBGT) technique. Where heat stress is a possibility, a heat stress monitoring device, such as the Wibget Heat Stress Monitor (Reuter Stokes) can be utilized.

The WBGT shall be compared to the Threshold Limit Values (TLV) outlined by the ACGIH TLV guides, and a work-rest regiment can be established in accordance with the WBGT. Note that 5 degrees C must be subtracted from the TLVs for heat stress listed to compensate for the wearing of impermeable protective clothing.

102.6.2 MEDICAL

In addition to the provisions of the WCC medical surveillance program, on-site medical monitoring of personnel should be performed by qualified medical personnel for projects where heat stress is a major concern. Blood pressure, pulse, body temperature (oral), and body weight loss should be taken and recorded.

Heart Rate: Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the same. If the heart rate still exceeds 110 beats per minute at the next rest cycle, shorten the following work cycle by one-third.

Oral Temperature: Use a clinical thermometer or similar device to measure the oral temperature at the end of the work period (before drinking liquids). If the oral temperature exceeds 99.6F (37.6C), shorten the next work cycle by one-third without changing the rest period. If the oral temperature still exceeds 99.6F (37.6C) at the beginning of the next rest period, shorten the following work cycle by one-third.

Do not permit a worker to wear a semipermeable or impermeable garment if his/her oral temperature exceeds 100.6F (38.1C).

Body Water Loss: Measure body weight on a scale accurate to ± 0.25 pounds at the beginning and end of each work day (also lunch break, if possible) to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, nude. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Portable water and Gatorade or other electrolyte replacement fluid should be available. Workers should be encouraged to drink fluids during rest periods.

Physiological Monitoring: Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 2). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

102.7 REFERENCES

American Conference of Governmental Industrial Hygienists,
Threshold Limit Values for Chemical Substances in the Work
Environment, 1984 - 1985.

Olishifski, J.B., Fundamentals of Industrial Hygiene, National
Safety Council, 1983.

National Institute for Occupational Safety and Health, The
Industrial Environment, Its Evaluation and Control, 1973.

/H&S2

OPERATING PROCEDURE NO. HS-203

203.0 RESPIRATOR INSPECTION, CARE, MAINTENANCE, AND STORAGE

203.1 PURPOSE

The purpose of this document is to provide guidance on the proper care and use of respiratory protective devices, to assist in adequately protecting personnel as well as complying with OSHA respiratory protection standard 1910.134. Guidance in the selection of respiratory devices is provided in OP No. HS 201.

203.2 APPLICABILITY

This procedure is applicable for use in caring for half-face and full-face respirators of either air-purifying or air supplying type. Proper care of respirators is essential for their satisfactory performance. Of importance is respirator inspection, care, maintenance, and storage.

203.3 REQUIREMENTS

OSHA requires, as part of an inspection program, that all respirators be leak checked, a determination that the complete assembly is gas tight. Follow field inspection procedures to examine the freshly cleaned, reassembled respirator.

Cleaning and Disinfecting - OSHA 1910.134 states "routinely used respirators shall be collected, cleaned and disinfected as frequently as necessary to ensure that proper protection is provided..." and that emergency use respirators "shall be cleaned and disinfected after each use."

The OSHA standard states that "replacement or repair shall be done by experienced persons with parts designed for the respirators." Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval (i.e., NIOSH, MSHA) of the device.

OSHA requires that respirators be stored to protect against:

- o Dust;
- o Sunlight;
- o Heat;
- o Extreme cold;
- o Excessive moisture;
- o Damaging chemicals; and
- o Mechanical damage.

The OSHA standard suggests that respirators be in their original cartons, however, this may provide only minimal protection from mechanical damage.

203.4 INSPECTION

203.4.1 AIR-PURIFYING RESPIRATORS

Routinely used air-purifying respirators should be checked as follows before and after each use:

1. **Examine the facepiece for:**

- o Excessive dirt;
- o Cracks, tears, holes or physical distortion of shape from improper storage;

- o Inflexibility of rubber facepiece (stretch and knead to restore flexibility);
- o Cracked or badly scratched lenses in full facepieces;
- o Incorrectly mounted full facepiece lenses, or broken or missing mounting clips; and
- o Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s), if required.

2. Examine the head straps or head harness for:

- o Breaks;
- o Loss of elasticity;
- o Broken or malfunctioning buckles and attachments; and
- o Excessively worn serrations on head harness, that might permit slippage (full facepieces only).

3. Examine the exhalation valve for the following after removing its cover:

- o Foreign material, such as detergent residue, dust particles or human hair under the valve seat;
- o Cracks, tears or distortion in the valve material;
- o Improper insertion of the valve body in the facepiece;
- o Cracks, breaks, or chips in the valve body, particularly in the sealing surface;
- o Missing or defective valve cover; and
- o Improper installation of the valve in the valve body.

4. Examine the air-purifying element for:

- o Incorrect cartridge, canister or filter for the hazard;
- o Incorrect installation, loose connections, missing or worn gasket or cross threading in the holder;
- o expired shelf-life date on the cartridge or canister; and
- o Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet.

5. If the device has a corrugated breathing tube, examine it for:

- o Broken or missing end connectors;
- o Missing or loose hose clamps; and
- o Deterioration, determined by stretching the tube and looking for cracks.

6. Examine the harness of a front-or back-mounted gas mask for:

- o Damage or wear to the canister holder, that may prevent its being held in place; and
- o Broken harness straps for fastening.

203.4.2 ATMOSPHERE-SUPPLYING RESPIRATORS

For a routinely used atmosphere-supplying device, use the following procedures:

1. If the device is a tight-fitting facepiece, use the procedures outlined under air-purifying respirators, except those pertaining to the air-purifying elements.
2. If the device is a hood, helmet, blouse or full suit, use the following procedures:
 - o Examine the hood, blouse or full suit for rips and tears, seam integrity, etc.;
 - o Examine the protective headgear, if required, for general condition with emphasis on the suspension inside the headgear;
 - o Examine the protective face shield, if any, for cracks or breaks or impaired vision; and
 - o Make sure the protective screen is intact and secured correctly over the face shield.
3. Examine the air supply systems for:
 - o Integrity and good condition of air supply lines and hoses, including attachment and end fittings; and
 - o Correct operation and condition of all regulators, or other air flow regulators.

In addition to the above, for self-contained breathing apparatus (SCBA) units also determine that:

1. The high pressure cylinder of compressed air or oxygen is sufficiently charged for the intended use, preferably full charged.
2. On closed circuit SCBA, a fresh canister of CO₂ (carbon dioxide) sorbent is installed.
3. On open circuit SCBA, the cylinder has been recharged if less than 25 percent of the useful service time remains.

All SCBAs are required to have a warning device that indicates when the 25 percent level is reached. However, it is recommended that an open-circuit SCBA be fully charged before use.

203.4.3 RESPIRATOR DISASSEMBLY

The used respirators should be collected and deposited in a central location. They are taken to an area where the filters, cartridges or canisters are removed and discarded. Canisters should be damaged or marked to prevent accidental reuse. If facepieces are equipped with reusable dust filters, they may be cleaned with compressed air in a hood. This prevents dust from getting into the room and affecting the respirator personnel. If SCBA are used, tanks are removed and connected to an area where the SCBA regulators and low-air warning devices are tested. SCBA facepieces are cleaned like air-purifying respirator facepieces.

203.4.4 DEFECTS FOUND IN FIELD INSPECTION

If defects are found during any field inspection, two remedies are possible. If the defect is minor, repair and/or adjustment may be made on the spot. If it is major, the device should be removed from service until it can be repaired. (A spare unit should replace the unit removed from service.) Under no

circumstances should a device that is known to be defective remain in the field.

203.4.5 INSPECTION DURING CLEANING

Because respirator cleaning usually involves some disassembly, it presents a good opportunity to examine each respirator thoroughly. The procedures outlined above for a field inspection should be used. Respirators should be inspected after cleaning operations and reassembly have been accomplished.

203.5 RESPIRATOR CARE

When used routinely, respirators should be exchanged daily for cleaning and inspection. Where respirators are used only occasionally, the exchange period could be weekly or monthly. workers maintaining their own respirators should be thoroughly briefed on cleaning and disinfecting them. Although workers may not be required to maintain their own respirators, briefing on the cleaning procedure will encourage their acceptance of a respirator by providing knowledge of what is a clean, disinfected, properly maintained device. This is particularly important where respirators are not individually assigned.

Where respirators are individually assigned (a practice to be encouraged), they should be identified to ensure that the worker always receives the same device. Identification markers must not penetrate the facepiece, block the filter, cartridge parts or exhaust valves.

When a relatively small number of respirators are used, or where workers clean their own respirators, the generally accepted procedure is washing with detergent and warm water using a brush, thoroughly rinsing in clean water, and drying in a clean

place. Precautions should be taken to prevent damage from rough handling during this procedure.

When large numbers of respirators are used, it is recommended that centralized cleaning and maintenance be performed and that specialized equipment and personnel trained in respirator maintenance be utilized.

203.5.1 CLEANING AND SANITIZING

The actual cleaning may be done in a variety of ways. A commercial dishwasher can be used. A standard domestic clothes washer may also be used if a rack is installed around the agitator to hold the facepieces in fixed positions. If the facepieces are placed loose in the washer, the agitator may damage them. A standard domestic dishwasher may be used, but it is not preferred because it does not immerse the facepieces. Any good detergent may be used followed by a disinfecting rinse or a combination disinfectant-detergent for a one step operation. Disinfection is not absolutely necessary if the respirator is reused by the same person. However, where individual issue is not practical, disinfection is strongly recommended. Reliable, effective disinfectants may be made from readily available household solutions, including:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately two milliliters of bleach (such as Chlorox) to one liter of water, or two tablespoons of bleach per gallon of water. A two-minute immersion disinfects the respirators.
2. Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or one teaspoon of tincture of

iodine per gallon of water. Again, a two-minute immersion is sufficient.

If the respirators are washed by hand, a separate disinfecting rinse may be provided. If a washing machine or dishwasher is used, the disinfectant must be added to the rinse cycle; the amount of water in the machine at that time will have to be measured to determine the correct amount of disinfectant.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140°F, but it should not be less than 120°F to ensure adequate cleaning. In addition, if commercial or domestic dishwashers are used, the drying cycle should be eliminated, since the temperatures reached in these cycles may damage the respirators.

203.5.2 RINSING

The cleaning and disinfected respirators should be rinsed thoroughly in water (140°F maximum) to remove all traces of detergent and disinfectants. This is very important for preventing dermatitis.

203.5.3 DRYING

The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes, but care must be taken not to damage or distort the facepieces. Another method is to equip a standard steel storage cabinet with an electric heater that has a built-in circulating fan, and to replace the solid steel shelves with steel mesh.

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203.5.4 REASSEMBLY AND INSPECTION

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks.

203.6 MAINTENANCE AND REPAIR

Maintenance personnel must be thoroughly trained. They must be aware of the limitations and never try to replace components or make repairs and adjustments beyond the manufacturer's recommendations, unless they have been specially trained by the manufacturer.

These restrictions apply primarily to maintenance of the more complicated devices, especially closed- and open-circuit SCBA, and more specifically, regulator valves and low pressures warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair. there should be no major problems in repairing and maintaining most respirators, particularly the commonly used air-purifying type.

An important aspect of any maintenance program is having enough spare parts on hand. Only continual surveillance of replacement rates will determine what parts and quantities should

be kept in stock. It is desirable to have a recording system to indicate spare parts usage and the inventory on hand.

For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

203.7 RESPIRATOR STORAGE

Damage and contamination of respirators may take place if they are stored on a workbench, or in a tool cabinet or toolbox, among heavy tools, greases and dirt. Freshly cleaned respirators should be placed in heat-sealed, ziplock, or other reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set."

Air-purifying respirators kept ready for non-routine or emergency use should be stored in a cabinet with individual compartments. The storage cabinet should be readily accessible, and all workers should be made aware of its location, as is done for fire extinguishers. Preventing serious injury from the inhalation of a toxic substance depends entirely on how quickly workers can get to the emergency respirators.

A chest or wall-mounted case may be used for storing SCBA for use in emergencies. Again, the location of SCBA should be well-known and clearly marked. Unlike fire extinguishers, however, they should be located in an area that will predictably remain uncontaminated. Putting on a SCBA in a highly contaminated atmosphere such as might be created by massive release of a toxic material may take too long a time to perform safety in that area.

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Therefore, the first reaction should be to escape to an uncontaminated area, then put on the SCBA, that should be located there, and re-enter the hazardous area for whatever task must be done. Exceptions to this rule may be encountered, and only a thorough evaluation of the process and escape routes will permit a final decision about the correct storage location for SCBA. Respirators should be stored in a plastic bag inside a rigid container.

Workers who are adequately trained should develop a respect for respirators that will be an automatic incentive to protect respirators from damage. Besides providing better assurance of adequate protection, this training will lower maintenance costs by decreasing damage.

203.8 RECORDKEEPING

Records should be maintained to document that proper care and maintenance has been performed on respiratory protection devices. Records should indicate when and what was done to each respirator, and also by whom.

203.9 REFERENCES

U.S. Department of Labor, OSHA, Safety and Health for General Industry (29 CFR Part 1910), Respiratory Protection 1910.134,
U.S. Department of Labor Occupational Safety and Health Administration.

American National Standard, Practices for Respiratory Protection, ANSI Z88.2-1980, American National Standards Institute.

Birkner, L.R., Respiratory Protection A Manual and Guideline, American Industrial Hygiene Association, 1980.

OPERATING PROCEDURE No HS-501

501 0 PERSONNEL DECONTAMINATION

501 1 GENERAL

The objective of these procedures is to minimize the risk of exposure to hazardous substances. These procedures were derived from the U.S. Environmental Protection Agency (EPA), Office of Emergency and Remedial Response's (OERR) Interim Standard Operating Safety Guides (revised September 1982). This version of the guides is in a format that is more appropriate for use in the field.

Decontamination procedures shall be communicated to employees, and implemented before any employees may enter areas on site where potential for exposure to hazardous substances exists. All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated. Decontamination procedures shall be monitored by the Site Safety and Health Officer (SSO) to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies. Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees to contaminated employees or equipment. Employees whose nonimpermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

The procedures for decontaminating personnel upon leaving the contaminated area are addressed for each of the EPA, OERR designated levels of protection, excluding Level D. Typical components of Levels B, C and D are provided in Section 7.2.2, Personal Protective Equipment Levels, of this health and safety plan. Adjustments may be required in the decontamination line configurations and procedures if ensemble components other than those specified in the health and safety plan are used.

If personnel decontamination is to be done in a manner not addressed in this SOP, those decontamination procedures must be formally established and all concerned employees briefed

Procedures are given for complete and abbreviated amounts of decontamination for each level of protection other than Level D. Complete decontamination procedures for all levels of protection will normally consist of 17-18 steps depending upon the PPE ensemble. Each station emphasizes an important aspect of decontamination. Utilizing all 17-18 steps will ensure that contaminant removal is as complete as feasible under field conditions. Abbreviated procedures are provided for situations when complete decontamination and removal of all personal protective equipment is not necessary. Examples of such situations include having to exchange breathing air bottles, taking a work break required to minimize heat stress, and when PPE ensembles other than those specified in the health and safety plan are employed. The abbreviated procedures are not suitable for work accomplished inside the 903 Pad (IHSS No. 112) or any other area wherein radiological contamination is detected as work progresses.

Decontamination lines are site-specific since they are dependent upon the contaminant species present, the degree of contamination, the specific items of PPE worn, and the type of work activities on site. Procedures specified herein may be modified by the SSO as the need arises. All modifications must be approved by the site manager. Normally, a phosphate-free soap in potable water solution will be used as the wash medium for personnel decontamination. When the decontamination line is no longer required, contaminated wash and rinse solutions and disposable articles must be contained and disposed of.

Radiological monitoring as described in EG&G, Radiological Operating Instructions, will be conducted for personnel and equipment departing all exclusion zones established in accordance with Title 29 Code of Federal Regulations (CFR) Part 1910.120, Hazardous Waste Operations and Emergency Response.

An exclusion zone's location determines who will conduct the monitoring. EG&G Radiation Protection Technicians (RPT) will monitor all personnel and equipment departing an exclusion zone that has been established within a controlled entry area designated by EG&G to limit

exposures to radioisotopes (i.e., 903 Pad). A contractor supplied SSO or Health and Safety Technician (HST) working for the SSO and assigned to a specific field team will conduct precautionary monitoring. Precautionary monitoring is described in Appendix A of this SOP. If an SSO or HST finds contamination levels greater than 250 counts per minute (cpm), all personnel and equipment will remain at the exclusion zone until an EG&G RPT arrives and assesses the situation.

The Contractor supplied SSO/HST will be responsible for completing Form 1.2, Personnel Decontamination Record.

501.2 EQUIPMENT

The types and amounts of decontamination required are largely dependent upon the types and amounts of contaminants that also dictate the ensemble being worn. Therefore, selection of the correct decontamination procedures and equipment is based upon the level of PPE being worn Table 1, Equipment Needed To Perform Decontamination Measures For Levels B, and C, and

Table 2, Equipment Needed to Perform Abbreviated Decontamination Measures for Levels B and C, define equipment necessary to implement procedures established by this SOP

501 3 LOCATION OF DECONTAMINATION LINES

Decontamination facilities (excluding showers and change rooms) will be located in the Contamination Reduction Zone (CRZ), that is, the area between the Exclusion Zone (the contaminated area) and the Support Zone (the clean area) as shown in Figure 1

501 4 CONFIGURATION OF DECONTAMINATION LINES

Decontamination procedures must provide an organized process by which levels of contamination are reduced. The decontamination process will consist of a series of procedures performed in a specific sequence. That is, outer, more heavily contaminated items (for example, outer boots and gloves) will be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items (such as, jackets and pants). Each procedure should be performed at a separate station in order to prevent cross contamination. The sequence of stations is called the decontamination line.

Stations should be separated physically to prevent cross contamination and should be arranged in order of decreasing contamination, preferably in a straight line. Entry and exit points should be conspicuously marked.

Decontamination lines for personnel wearing various levels of protection are provided in Figure 2, Decontamination Layout - Level B Protection, Figure 3, Decontamination Layout - Level C Protection, Figure 4, Abbreviated Decontamination Layout - Level B Protection, and Figure 5, Abbreviated Decontamination Layout - Level C Protection.

TABLE 1
EQUIPMENT NEEDED TO PERFORM DECONTAMINATION MEASURES
FOR LEVELS A, B, AND C

Station 1	<ul style="list-style-type: none"> a Various Size Containers b Plastic Liners c Plastic Drop Cloths 	Station 10	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners c Bench or Stools d Boot Jack
Station 2	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Decon Solution or Detergent Water c 2-3 Long-Handled, Soft-Bristled Scrub Brushes 	Station 11	<ul style="list-style-type: none"> a Rack b Drop Cloths c Bench or Stools
Station 3	<ul style="list-style-type: none"> a Containers (20-30 Gallons) OR High-Pressure Spray Unit b Water c 2-3 Long-Handled, Soft-Bristled Scrub Brushes* 	Station 12	<ul style="list-style-type: none"> a Table
Station 4	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners 	Station 13	<ul style="list-style-type: none"> a Basin or Bucket b Decon Solution c Small Table
Station 5	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners c Bench or Stools 	Station 14	<ul style="list-style-type: none"> a Water b Basin or Bucket c Small Table
Station 6	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners 	Station 15	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners
Station 7	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Decon Solution or Detergent Water c 2-3 Long-Handled, Soft-Bristled Scrub Brushes* 	Station 16	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners
Station 8	<ul style="list-style-type: none"> a Containers (20-30 Gallons) OR High-Pressure Spray Unit b Water c 2-3 Long-Handled, Soft-Bristled Scrub Brushes* 	Station 17	<ul style="list-style-type: none"> a Containers (20-30 Gallons) b Plastic Liners c Radiation Monitor
Station 9	<ul style="list-style-type: none"> a Air Tanks or Face Masks and Cartridge Depending on Level b Tape c Boot Covers d Glove 	Station 18	<ul style="list-style-type: none"> a Water b Soap c Small Table d Basin or Bucket e Showers f Towels
		Station 19	<ul style="list-style-type: none"> a Dressing Room is Needed b Tables c Chairs d Lockers e Cloths

*Brushes will not be used to remove radiological contamination from bare skin

TABLE 2
EQUIPMENT NEEDED TO PERFORM ABBREVIATED DECONTAMINATION
MEASURES FOR LEVELS A, B, AND C

Station 1	a	Various Size Containers	Station 4	a	Air Tanks or Masks and Cartridges Depending Upon Level
	b	Plastic Liners		b	Tape
	c	Plastic Drop Cloths		c	Boot Covers
Station 2	a	Containers (20-30 Gallons)	Station 5	d	Gloves
	b	Decon Solution		a	Containers (20-30 Gallons)
	c	Rinse Water		b	Plastic Liners
	d	2-3 Long-Handled, Soft-Bristled Scrub Brushes*		c	Bench or Stools
Station 3	a	Containers (20-30 Gallons)	Station 6	a	Plastic Sheets
	b	Plastic Liners		b	Basin or Bucket
	c	Bench or Stools		c	Soap and Towels
				d	Bench or Stools
			Station 7	a	Water
				b	Soap
				c	Tables
				d	Wash Basin or Bucket

*Brushes will not be used to remove radiological contamination from bare skin

FIGURE 1
SITE WORK ZONES

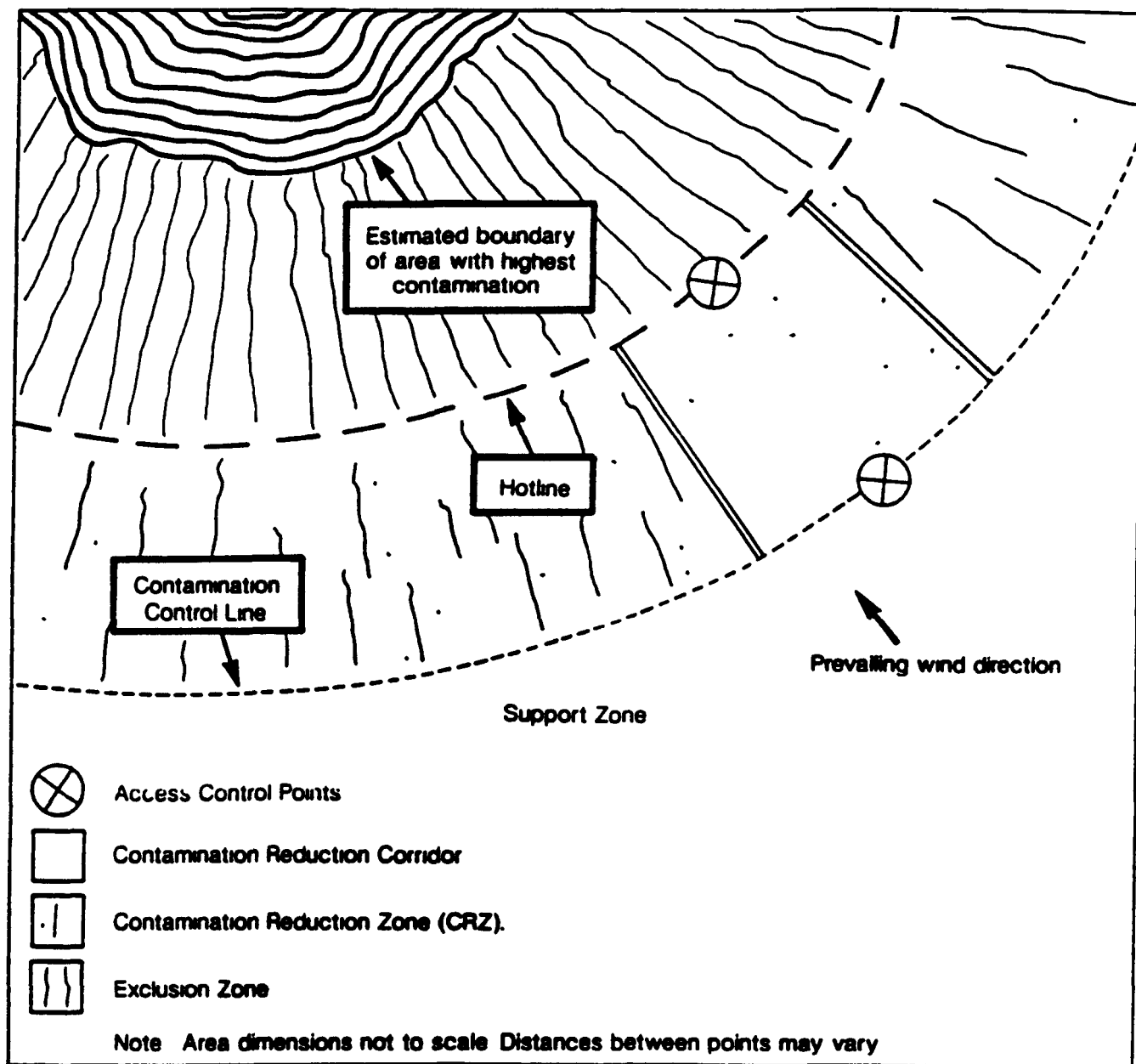


FIGURE 2
DECONTAMINATION LAYOUT
LEVEL B PROTECTION

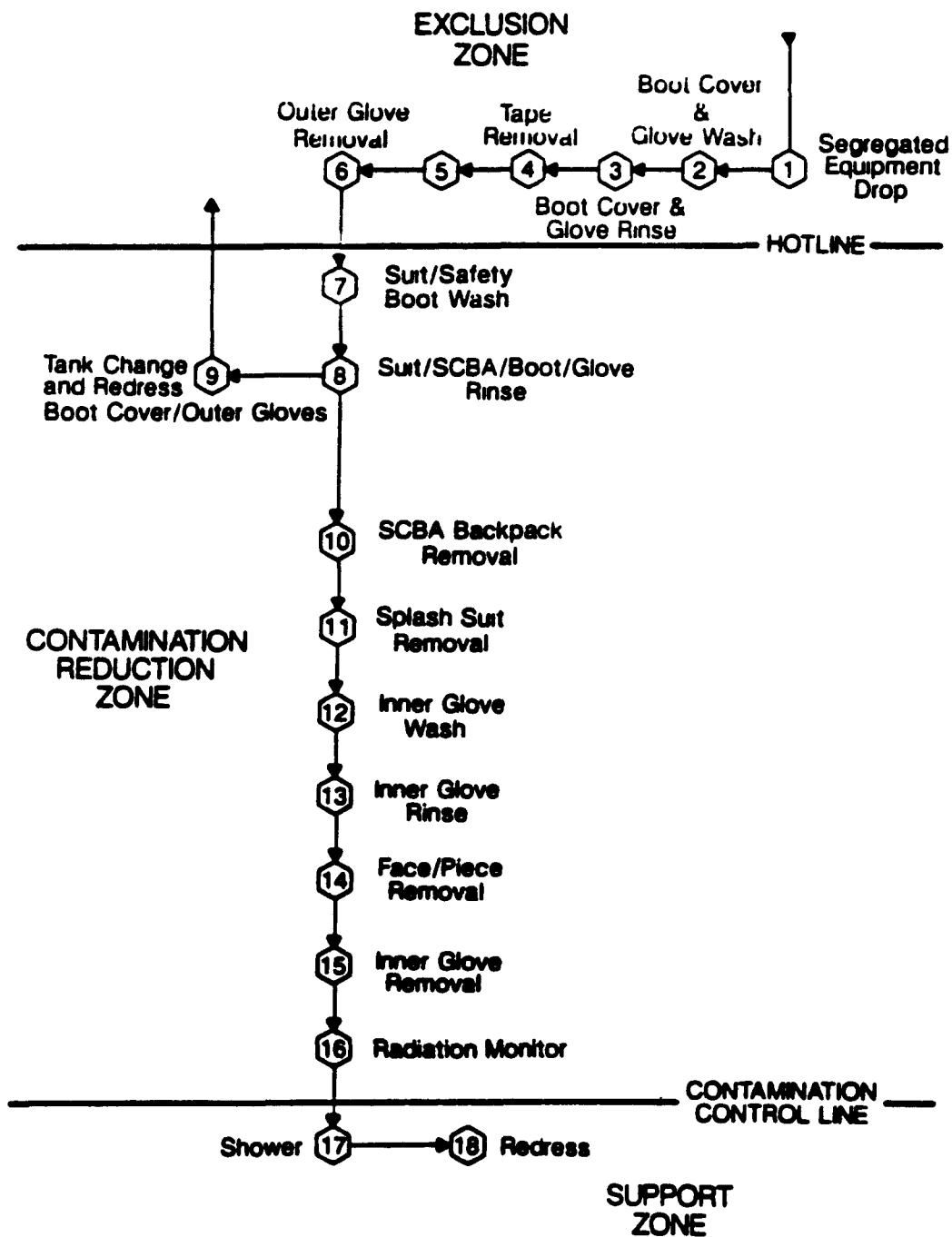
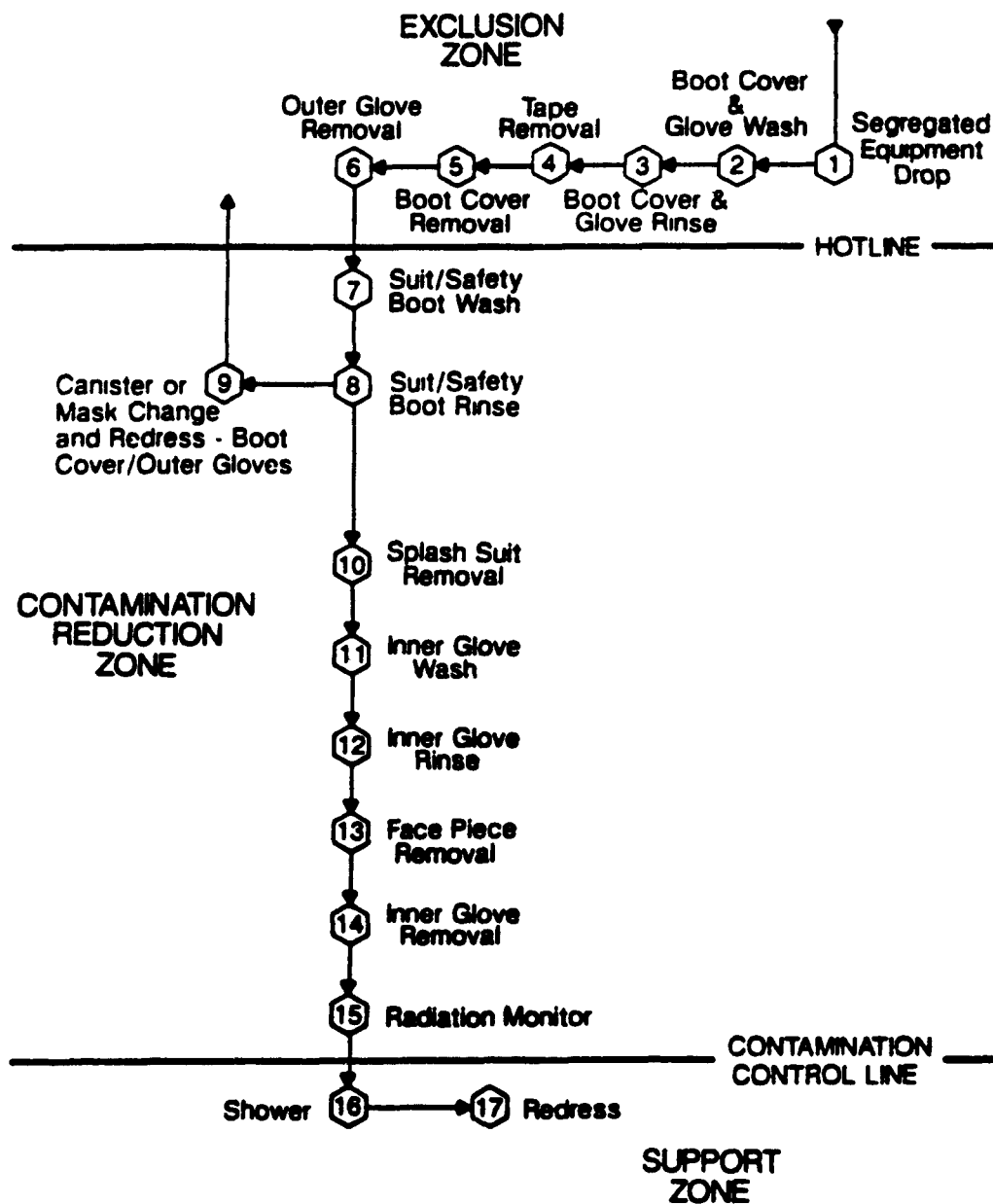


FIGURE 3

DECONTAMINATION LAYOUT
LEVEL C PROTECTION



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ABBREVIATED DECONTAMINATION LAYOUT
LEVEL B PROTECTION

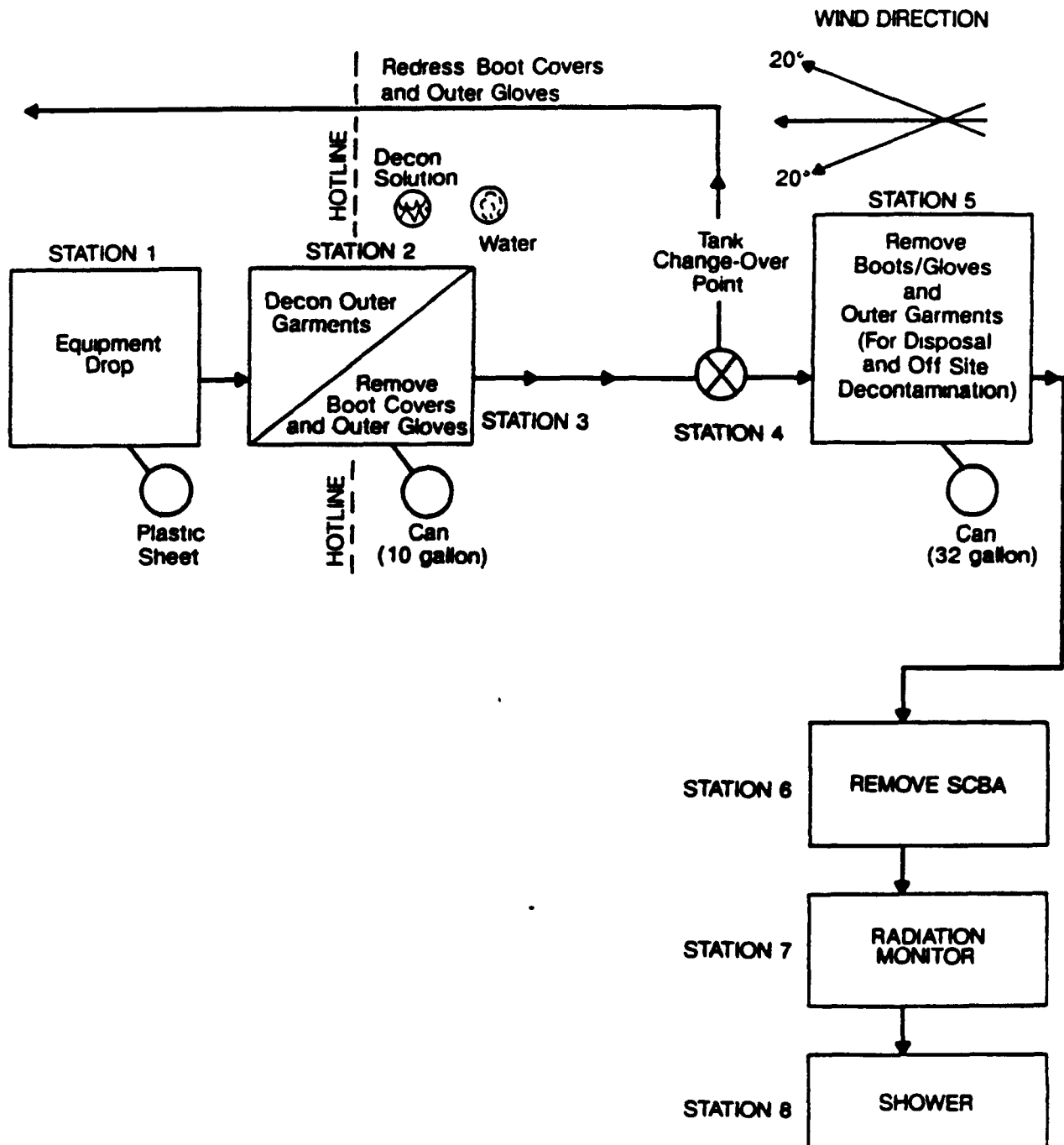
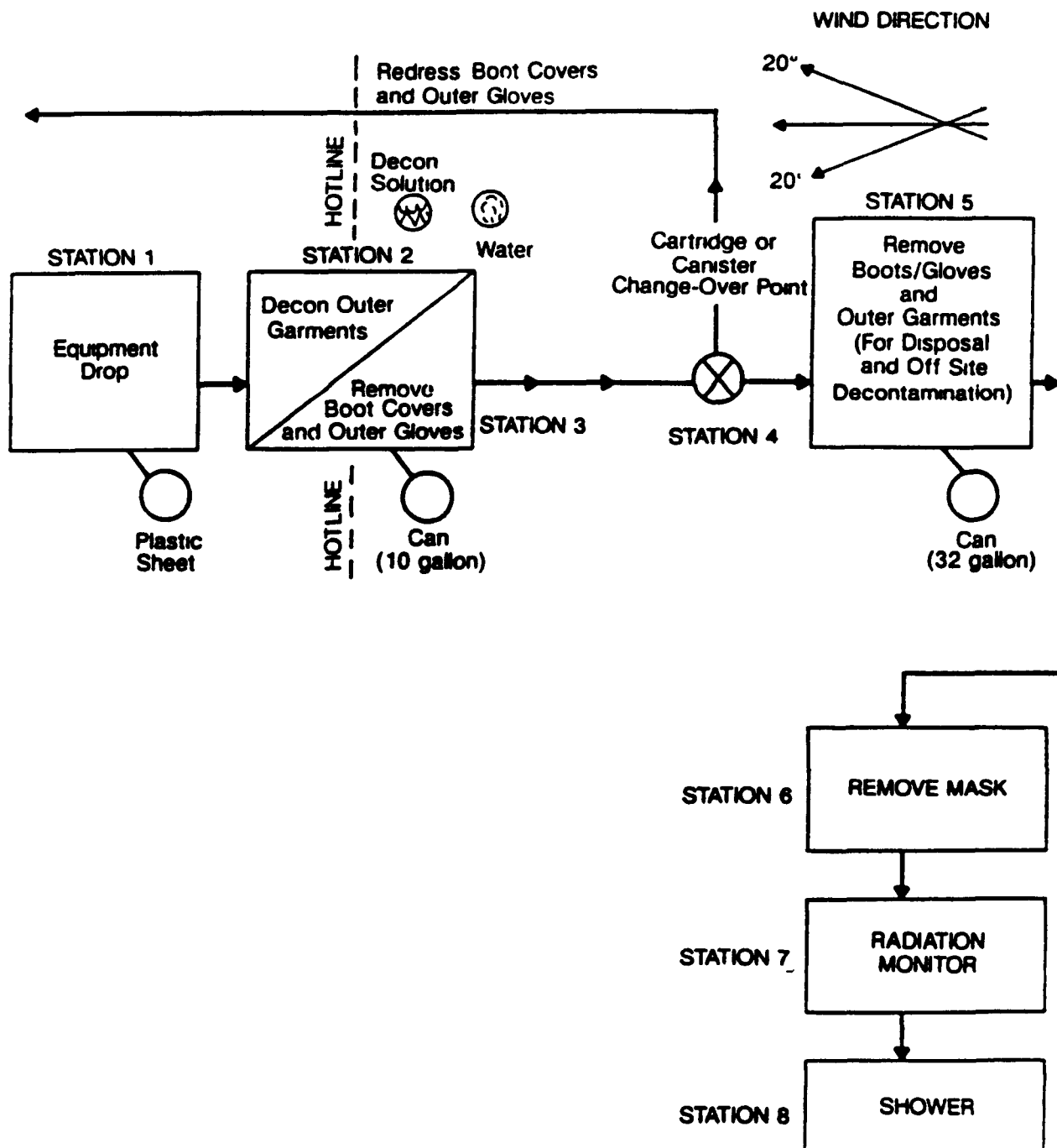


FIGURE 5

ABBREVIATED DECONTAMINATION LAYOUT
LEVEL C PROTECTION



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501.5 PROCEDURES FOR PERSONNEL DECONTAMINATION

Decontamination procedures must provide an organized process by which levels of contamination are reduced. The decontamination process should consist of a series of procedures performed in a specific sequence. For example, outer, more heavily contaminated items (such as, outer boots and gloves) should be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items (such as, jackets and pants). Each procedure should be performed at a separate station in order to prevent cross contamination. The sequence of stations is called the decontamination line. The procedure (such as boot wash) to be accomplished at a given station will be clearly indicated so that a person at that station knows what is required. Decontamination procedures for various levels of protection are provided in Table 2, Procedures for Level B Decontamination; Table 3, Procedures for Level C Decontamination; Table 4, Abbreviated Procedures for Level B Decontamination; and Table 5, Abbreviated Procedures for Level C Decontamination. These procedures are for situations which warrant the maximum amount of PPE items for a given PPE level as specified in the health and safety plan. Certain operations may require a variant of the specified PPE ensembles which will require a modification in the decontamination procedures.

All equipment and fluids used for decontamination must be decontaminated and/or disposed of properly. Buckets, brushes, clothing, tools, and other contaminated equipment will be collected and decontaminated

TABLE 2
PROCEDURES FOR LEVEL B DECONTAMINATION

Station 1	Segregated Equipment Drop	1	Deposit equipment used on site (tools sampling devices and containers monitoring instruments, radios clipboards etc) on plastic drop cloths or in different containers with plastic liners Segregation at the drop reduces the probability of cross contamination
Station 2	Boot Cover and Glove Wash	2	Scrub outer boot covers and gloves with decon solution or detergent and water
Station 3	Boot Cover and Glove Rinse	3	Rinse off decon solution from station 2 using copious amounts of water
Station 4	Tape Removal	4	Remove tape around hoods and gloves and deposit in container with plastic liner
Station 5	Boot Cover Removal	5	Remove boot covers and deposit in container with plastic liner
Station 6	Outer Glove Removal	6	Remove outer gloves and deposit in container with plastic liner
Station 7	Suit and Safety Boot Wash	7	Wash chemical-resistant splash suit SCBA gloves and safety boots Scrub with long-handled scrub brush and decon solution Wrap SCBA regulator (if belt mounted type) with plastic to keep out water Wash backpack assembly with sponges or cloths
Station 8	Suit, SCBA, Boot, and Glove Rinse	8	Rinse off decon solution using copious amounts of water
Station 9	Tank Change	9	If worker leaves exclusion zone to change air tank, this is the last step in the decontamination procedure Worker's air tank is exchanged, new outer gloves and boot covers put on and joints taped Worker returns to duty
Station 10	SCBA Backpack Removal	10	While still wearing facepiece remove backpack and place on table Disconnect hose from regulator valve
Station 11	Splash Suit (such as saranex) Removal	11	With assistance of helper remove splash suit Deposit in container with plastic liner
Station 12	Inner Glove Wash	12	Wash inner gloves with decon solution
Station 13	Inner Glove Rinse	13	Rinse inner gloves with water

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TABLE 2
(Continued)

Station 14	Facepiece Removal	14	Remove facepiece. Deposit in container with plastic liner. Avoid touching face with fingers.
Station 15	Inner Glove Removal	15	Remove inner gloves and deposit in container with liner.
Station 16	Inner Clothing Removal	16	Remove inner clothing. Place in container with liner. Do not wear inner clothing off site since there is a possibility that small amounts of contaminants might have been transferred in removing the fully encapsulating suit. Radiation monitoring will be done here.*
Station 17	Field Wash	17	Wash hands and face if shower is not available.
Station 18	Redress	18	Proceed to showers and put on clean clothes.

*If radiological contamination is found the SSO will provide instructions for decontamination.

TABLE 3
PROCEDURES FOR LEVEL C DECONTAMINATION

Station 1	Segregated Equipment Drop	1	Deposit equipment used on site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc) on plastic drop clothe or in different containers with plastic liners Segregation at the drop reduces the probability of cross contamination
Station 2	Boot Cover and Glove Wash	2	Scrub outer boot covers and gloves with decon solution or detergent and water
Station 3	Boot Cover and Glove Rinse	3	Rinse off decon solution from station 2 using copious amounts of water
Station 4	Tape Removal	4	Remove tape around boots and gloves and deposit in container with plastic liner
Station 5	Boot Cover Removal	5	Remove boot covers and deposit in container with plastic liner
Station 6	Outer Glove Removal	6	Remove outer gloves and deposit in container with plastic liner
Station 7	Suit and Boot Wash	7	Wash splash suit, gloves and safety boots Scrub with long-handled scrub brush and decon solution
Station 8	Suit and Boot, and Glove Rinse	8	Rinse off decon solution using water Repeat as many times as necessary
Station 9	Canister or Mask Change	9	If worker leaves exclusion zone to change canister (or mask), this is the last step in the decontamination procedure Worker's canister is exchanged n.w outer gloves and boot covers put on and joints taped then worker returns to duty
Station 11	Splash Suit (such as saranex) Removal	11	With assistance of helper remove splash suit Deposit in container with plastic liner
Station 11	Inner Glove Wash	11	Wash inner gloves with decon solution
Station 12	Inner Glove Rinse	12	Rinse inner gloves with water
Station 13	Facepiece Removal	13	Remove facepiece Deposit in container with plastic liner Avoid touching face with fingers
Station 14	Inner Glove Removal	14	Remove inner gloves and deposit in lined container

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TABLE 3
(Continued)

Station 15	Inner Clothing (such as tyvek) Removal	15	Remove clothing soaked with perspiration and place in lined container. Do not wear inner clothing off site since there is a possibility that small amounts of contaminants might have been transferred in removing the fully encapsulating suit. Radiation monitoring will be done here.
Station 16	Field Wash	16	Wash hands and face if shower is not available.
Station 17	Redress	17	Proceed to shower and put on clean clothes.

*If radiological contamination is found the SSO will provide instructions for decontamination

TABLE 4
ABBREVIATED PROCEDURES FOR LEVEL B DECONTAMINATION

Station 1	Equipment Drop	1	Deposit equipment used on site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination.
Station 2	Outer Garment, Boots, and Gloves chemical - Wash and Rinse	2	Scrub outer boots, outer gloves and resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3	Outer Boot and Glove Removal	3	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4	Tank Change	4	If worker leaves exclusion zone to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged, new outer gloves and boot covers put on, joints taped and worker returns to duty. During hot weather operations, cool down stations may be set up within this area.
Station 5 gloves	Boots, Gloves, and Outer Garment Removal	5	Boots, chemical-resistant splash suit, inner removed and deposited in separate containers lined with plastic.
Station 6	SCBA Removal	6	SCBA backpack and facepiece are removed (avoid touching face with fingers). SCBA deposited on plastic sheets.
Station 7	Monitor	7	Radiation Monitor*
Station 8	Field Wash	8	Hands and face are thoroughly washed. Shower as soon as possible.

*If radiological contamination is found the SSO will provide instructions for decontamination.

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TABLE 5
ABBREVIATED PROCEDURES FOR LEVEL C DECONTAMINATION

Station 1	Equipment Drop	1	Deposit equipment used on site (tools, sampling devices and containers monitoring instruments, radios, clipboards, etc) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination.
Station 2	Outer Garment, Boots, and Gloves splash suit Wash and Rinse	2	Scrub outer boots, outer gloves and with decontamination or detergent and water. Rinse off using copious amounts of water.
Station 3	Outer Boot and Glove Removal	3	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4	Canister or Mask Change	4	If worker leaves exclusion zone to change canister (or mask) this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers put on, joints taped and worker returns to duty. During hot weather operations cool down stations may be set up within this area.
Station 5	Boots, Gloves, and Outer Garment gloves Removal	5	Boots, chemical-resistant splash suit, inner removed and deposited in separate containers lined with plastic.
Station 6	Facepiece Removal	6	Facepiece is removed (avoid touching face with fingers). Facepiece deposited on plastic sheet.
Station 7	Monitor	7	Radiation Monitor
Station 8	Field Wash	8	Hands and face are thoroughly washed. Shower as soon as possible.

*If radiological contamination is found the SSO will provide instructions for decontamination.

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501 6 EMERGENCY PROCEDURES

In general, emergency procedures established by the applicable health and safety plan apply

501.6 1 Life Threatening Injuries

In an emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. If immediate medical treatment is required to save a life or limb, decontamination will be delayed until the victim is stabilized. If decontamination is to be delayed, wrap the victim in blankets, plastic, or rubber to reduce contamination. Emergency response personnel should be alerted to the potential contamination.

501.6.2 Nonthreatening Injuries

If the injury does not threaten life or limb, routine decontamination procedures should be used.

501.6.3 THERMAL STRESS

If an emergency due to a heat-related illness develops, protective clothing should be removed from the victim as soon as possible to reduce the heat stress, and emergency procedures for heat stress should be implemented immediately

501 7 DOCUMENTATION

The amount and type of documentation maintained is dependent upon type of operation in progress.

501.7.1 Routine Operations

A Personnel Decontamination Record (Form 1.2) will be completed daily by the SSO/HST for each exclusion zone established.

501.7.2 Operations That Result in Personnel or Equipment Becoming Contaminated With Radioactive Materials

An EG&G RPT will be contacted immediately if a Ludlum Model 12-1A count rate meter indicates the presence of radioactive materials in a controlled entry area designated by EG&G to limit exposures to radioisotopes. The RPT will verify the presence of radioactive materials and complete the pertinent forms as specified in EG&G ROI.

PERSONNEL DECONTAMINATION RECORD

Personnel Inside Exclusion Zone

Name	Position
_____	_____ Team Leader
_____	_____ H&S Technician
_____	_____ Driller
_____	_____ Driller's Helper
_____	_____ Air Technician
_____	_____ Other, specify

PPE Level Worn

_____ A _____ B _____ C _____ D

Assigned Task (check appropriate task)

___ Well Construction ___ Well Development
___ Soil Boring ___ Surficial Soil Sampling
___ Other, specify

Work Location

Operable Unit _____

Additional Locating Information

Results of Environmental Monitoring (record highest measurement noted and units)

Radiological

Instrument Used _____ Higher Measurement _____

Note: If radiological contamination is found, record the name of the RPT that responds.

Ambient Air

Instrument Used _____ Higher Measurement _____
Instrument Used _____ Higher Measurement _____

Decontamination (describe by reference to a figure and table provided in SOP or attach a diagram of layout with
a description of the procedure)

Layout described in Figure _____

Procedure described in Table _____

Additional Remarks (include description of any emergency decontamination accomplished and summary of RPT
actions if previously unsuspected radiological contamination was found and names of personnel or equipment found
to be radiologically contaminated as well as name of RPT that responded to the site)

Completed by _____ Date _____ Subcontractor _____
(Name and Phone)

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APPENDIX A
PRECAUTIONARY MONITORING

1 PURPOSE

To establish personnel monitoring requirements for radioactive contamination

2 SCOPE

This instruction defines the use of instruments for personnel contamination monitoring, criteria for personnel contamination, and management of contaminated personnel

3 GENERAL

3 1 If a radiological occurrence involves a combination of conditions, response actions shall be taken in the following priority:

- Critical injury or illness
- Skin contamination
- Noncritical injury or illness
- Possible inhalation of radioactive material

3 2 Emergency medical care of critically injured or ill personnel shall take precedence over radiological actions

3 3 Care shall be exercised in transporting contaminated personnel to minimize the spread of contamination outside of the exclusion zone. A blanket or other material will be used to cover a contaminated person that leaves the exclusion zone.

4 INSTRUCTIONS

4 1 Monitoring of personnel for contamination shall be performed in the following situations

- Whenever leaving a Controlled Area designated by EG&G such as the 903 Pad.
- Whenever exiting a Contaminated Area as indicated by environmental monitoring conducted as field work progressed

4 1.1 Alpha contamination monitoring shall be performed as follows

- The Ludlum Model 12-1A Survey Meter with an Air Proportional Detector shall be used

- The detector shall be held within $\frac{1}{4}$ inch of the body or clothing surface and moved slowly, i.e., about 1 inch per second
- To the extent practical, clothing wrinkles shall be smoothed prior to monitoring
- The instrument scale selector control shall be set to the range appropriate for measuring levels of contamination.
- Visual or audible instrument response shall be used to determine the presence of contamination
- Skin or clothing shall be considered contaminated if the detectable radioactivity is greater than 250 cpm

4.1.2 Precautionary monitoring shall consist of a whole-body survey. A whole-body survey shall be conducted front and back as the individual being surveyed stands with legs spread and arms extended out from the shoulders as the probe is moved over the following areas or articles

- Head (pause at mouth and nose)
- Neck and shoulders
- Arms (pause at each elbow)
- Hands (pause at palm and back)
- TLD and security badge
- Respirator, exterior, interior, cartridge, and straps
- Chest and abdomen
- Back, hips, and seat of pants
- Legs (pause at each knee)
- Pant cuffs (pause)
- Shoe cover bottoms
- Shoe tops
- Shoe bottoms (pause at sole and heel)

4.1.3 An EG&G RPT and the SSO shall be contacted if greater than 250 cpm is detected after completion of the personnel decontamination procedures. The individual found to be contaminated and the individual that performed the monitoring will remain at the personnel decontamination station.

OPERATING PROCEDURE NO. HS-509

509.0 SAFETY GUIDELINES FOR DRILLING INTO SOIL AND ROCKS

509.1 PURPOSE

The purpose of this operating procedure is to provide guidelines for safe conduct of drilling operations with truck-mounted and other engine-powered, drill rigs. The procedure addresses off-road movement of drill rigs, overhead and buried utilities, use of augers, rotary and core drilling, and other drilling operations and activities.

509.2 APPLICATION

The guidelines shall be applied in all WCC/WCFS projects in which truck-mounted, or other engine-powered, drill rigs are used. The guidelines are applicable to WCC employees and WCC award rigs. For drill rigs operated by contractors, drill rig safety is the responsibility of the contractor.

509.3 RESPONSIBILITY AND AUTHORITY

Drill rig safety and maintenance is the responsibility of the drill rig operator.

509.4 SAFETY GUIDELINES

509.4.1 MOVEMENT OF DRILL RIGS

Before moving a rig, the operator must do the following:

1. To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
2. Check the brakes of the truck/carrier, especially if the terrain along the route of travel is rough or sloped.
3. Discharge all passengers before moving on rough or steep terrain.
4. Engage the front axle (on 4x4, 6x6, etc. vehicles) before traversing rough or steep terrain.

Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator must conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility that the presence of drilling tools on the rig may reduce the ability of the rig to remain upright by raising the center of mass of the rig must be considered.

Logs, ditches, road curbs, and other long and horizontal obstacles should be normally approached and driven over squarely, not at an angle.

When close lateral or overhead clearance is encountered, the driver of the rig should be guided by another person on the ground.

Loads on the drill rig and truck must be properly stored while the truck is moving, and the mast must be in the fully lowered position.

After the rig has been positioned to begin drilling, all brakes and/or locks must be set before drilling begins. If the rig is positioned on a steep grade and leveling of the ground is impossible or impractical, the wheel of the transport vehicle should be blocked and other means of preventing the rig from moving or topping over employed.

509.5 BURIED AND OVERHEAD UTILITIES

The location of overhead and buried utility lines must be determined before drilling begins, and their locations should be noted on boring plans or assignment sheets.

When overhead power lines are close by, the drill rig mast should not be raised unless the distance between the rig and the nearest power line is at least 20 feet or other distance as required by local ordinances, whichever is greater. The drill rig operator or assistant should walk completely around the rig to make sure that proper distance exists.

When the drill rig is positioned near an overhead line, the rig operator should be aware that hoist lines and power lines can be moved towards each other by wind. When necessary and approved by the PM and the utility, powerlines may be shielded, shut down, or moved by the appropriate personnel.

509.6 CLEARING THE WORK AREA

Before a drill rig is positioned to drill, the area on which the rig is to be positioned should be cleared of removable obstacles and the rig should be leveled if sloped. The cleared/leveled area should be large enough to accommodate the rig and supplies.

509.7 SAFE USE OF AUGERS

Never place hands or fingers under the bottom of an auger flight or drill rods when hoisting the augers or rods over the top of another auger or rod in the ground or other hard surfaces, such as the drill rig platform.

Never allow feet to get under the auger or drill rod while they are being hoisted.

When drill is rotating, stay clear of the drill string and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.

Move auger cuttings away from the auger with a long-handled shovel or spade; never use hands or feet.

Never clean an auger attached to the drill rig unless the transmission is in neutral or the engine is off, and the auger has stopped rotating.

509.8 SAFE USE OF HAND TOOLS

OSHA regulations regarding hand tools should be observed in addition to the guidelines provided below:

1. Each tool should be used only to perform tasks for which it was originally designed.
2. Damaged tools should be repaired before use or discarded.
3. Safety goggles or glasses should be worn when using a hammer or chisel. Nearby co-workers and by-standers should be required to wear safety goggles or glasses also or to move away.
4. Tools should be kept cleaned and stored in an orderly manner when not in use.

509.9 SAFE USE OF WIRE LINE HOISTS, WIRE ROPE, AND HOISTING HARDWARE

Safety rules described in 29 CFR 1926.552 and guidelines contained in the Wire RPE User's Manual published by the American Iron and Steel Institute shall be used whenever wire line hoists, wire rope, or hoisting hardware are used.

509.10 PROTECTIVE GEAR

509.10.1 MINIMUM PROTECTIVE GEAR

Items listed below should be worn by all members of the drilling team while engaged in drilling activities.

- o Hard Hat;
- o Safety Shoes (shoes or boots with steel toes and shanks); and
- o Gloves.

509.10.2 OTHER GEAR

Items listed below should be worn when conditions warrant their use. Some of the conditions are listed after each item.

1. **Safety Goggles or Glasses:** Use when: (1) driving pins in and out of drive chains, (2) replacing keys in tongs, (3) handling hazardous chemicals, (4) renewing or tightening gauge glasses, (5) breaking concrete, brick, or cast iron, (6) cleaning material with chemical solutions, (7) hammering or sledging on chisels, cold cuts, or bars, (8) cutting wire lines, (9) grinding on abrasive wheels, (10) handling materials in powered or semi-powered form, (11) scraping metal surfaces, (12) sledging rock bits or core heads to tighten or loosen them, (13) hammering fittings and connections, and (14) driving and holding rivets.
2. **Safety Belts and Lifelines:** Safety belts and lifelines should be worn by all persons working on top of an elevated derrick beam. The lifeline should be secured at a position that will allow a person to fall no more than eight feet.
3. **Life Vests:** Use for work over water.

509.11 TRAFFIC SAFETY

Drilling in streets, parking lots or other areas of vehicular traffic requires definition of the work zones with cones, warning tape, etc. and compliance with local police requirements.

509.12 FIRE SAFETY

1. Fire extinguishers shall be kept on or near drill rigs for fighting small fires.
2. If methane is suspected in the area, a combustible gas instrument (CGI) shall be used to monitor the air near the borehole with all work to stop at 25 percent of the Lower Explosive Limit.
3. Work shall stop during lightning storms.

/H&S2

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OPERATING PROCEDURE NO. HS-510

510.0 SAFETY PROCEDURES FOR TRENCH CONSTRUCTION AND OTHER EXCAVATING OPERATIONS

510.1 PURPOSE

This procedure contains general safety requirements for excavating and trenching operations and work performed therein. The requirements are consistent with standards established by the Occupational Safety and Health Administration (OSHA) and described in 29 CFR 1926.650. The detailed OSHA standard was effective in January 1990 and should be consulted before design of a shoring system or questions regarding a sloping option.

510.2 PRIMARY RESPONSIBILITY

The WC project manager is responsible for ensuring that employees of WC and of firms contracted by WC comply with the requirements.

WC employees are responsible for not entering improper trenches or excavations.

510.3 APPLICABILITY

This procedure is applicable to all WC projects in which trenching or other excavating operations, exclusive of borings, are entered by WC personnel or personnel employed by firms under contract to WC. It is also applicable to WC projects requiring WC personnel or personnel of firms under contract to WC to enter trenches and other types of excavations.

The best approach for avoiding the detailed trenching requirements is to perform sampling and other procedures without entry into excavations. Use of a backhoe to bring up samples, use of long-handled sampling devices, and similar techniques are recommended.

510.4 REQUIREMENTS

510.4.1 PRELIMINARY REQUIREMENTS

Certain government agencies (e.g. California) require a permit to perform excavation operations.

Before digging, determine or have the client determine if underground installations, such as sewer, water, fuel, or electrical lines are to be encountered, and if so, determine the exact locations of the lines. Information can be obtained by contacting Underground Service Alert (consult local telephone directory for toll-free number), local utility companies, and the owner of the property on which excavating operations are planned.

Trees, boulders, and other surface encumbrances, located so as to pose a potential hazard to employees must be removed or made safe before the operation begins.

510.4.2 PLACEMENT OF EXCAVATED MATERIALS

Excavated materials must be placed at least two feet back from the edge of the excavation and precautions must be taken to prevent the materials from falling into the excavation.

510.4.3 WORKING IN EXCAVATIONS

510.4.3.1 SHORING AND SLOPING

Trenches in which personnel are required to work must be shored or sloped if the depth of the excavation is five (5) feet or more. When a shoring system is used, it shall consist of hydraulic shores or the equivalent, with sheathing or sheet piling as needed. Trench boxes are also permitted. OSHA uses a soil classification system to determine the allowable slopes for trenches. The shoring system must be properly designed and installed to sustain all existing and expected loads. For details on shoring and sloping, consult 29 CFR, Subpart P, Sections 1926.650 to 1926.653.

510.4.3.2 ACCESS

When work is to be performed in any excavation, safe access to the excavation must be provided by means of ladders, stairs, or ramps. Trenches four or more feet deep must have ladders spaced no less than 25 feet apart, and the ladders must extend at least three feet above grade.

510.4.3.3 HAZARDOUS ATMOSPHERES

At sites where oxygen deficiency or hazardous concentrations of flammable or toxic vapors or gases may be encountered in excavations, the atmosphere in the excavations must be tested by the project safety officer or other qualified person before work in an excavation begins and at appropriate intervals afterward.

510.4.4 INSPECTION OF EXCAVATIONS

Excavations must be observed daily by the project or site safety officer. If no safety officer has been assigned to the project, inspections must be made by the project manager or his designee. If evidence for potential cave-ins or slides is apparent, all work in the excavation must be suspended until necessary steps have been taken to safeguard employees.

510.4.5 OPERATION OF VEHICLES NEAR EXCAVATIONS

When vehicles or heavy equipment must operate near an excavation, the sides of the excavation must be shored or braced as necessary to withstand forces exerted by the superimposed load and the earth pressure. Stop logs or other types of secure barriers must be installed at the edges of the excavations.

510.4.6 BELL-BOTTOM PIER HOLES

Employees entering drilled pier holes must be protected by a casing proportioned to sustain the maximum stresses imposed by earth and water or slurry that extends the full depth of the shaft and to the bottom of the bell. A safety cage or a shoulder harness secured to a full-time tended lifeline shall be required for entry and exit.

510.4.7 BRIDGES AND WALKWAYS

Walkways or bridges with standard guardrails must be provided where employees or equipment are required or permitted to cross over excavations. Pedestrian walkways shall be of sufficient strength to permit a vertical deflection of no more than 0.5 inch when a 250-pound weight is applied to the center of the walkway.

All bridges intended for vehicular traffic must be constructed to withstand twice the load of the heaviest vehicle expected.

510.4.8 BARRICADES AND FENCES

Excavated areas must be completely guarded on all sides with barricades or fences, as appropriate. If barricades are used, they must be spaced no more than 20 feet apart and shall not be less than 35 inches high when erected. A yellow or yellow and black tape, at least 0.75 inches wide, shall be stretched between the barricades.

510.4.9 BACKFILLING

Excavated areas must be backfilled in accordance with the work plan as soon as practical after work is completed, and all associated equipment must be removed from the area.

510.5 EXCAVATIONS NEXT TO EXISTING STRUCTURES

A registered engineer will review all plans for excavations next to existing structures to avoid undermining the structures and possible collapse.

/H&S2

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ATTACHMENT E

ESTIMATING AIRBORNE CONCENTRATIONS OF RADIOISOTOPES FROM SOILS

1. Mathematical Modeling

We have used the mass-loading method of estimating airborne concentrations of radioisotopes likely to be encountered from soil sources during field operations. No attempt has been made to estimate the airborne concentration of radioisotopes from liquid sources since it is extremely unlikely that liquid aerosols will be generated. Specifically, we have used the mass-loading approach as described in US Environmental Protection Agency (EPA) document Number EPA 520/1-9-90-016, Transuranium Elements - Volume 2 Technical Basis For Remedial Actions, dated June 1990, specifically Chapter 6, Radiological Assessment - Rocky Flats Plant. Pertinent sections of this chapter (hereafter simply referred to as "Chapter 6") have been extracted and are presented in this Attachment. It may be of use to review "Chapter 6" before proceeding

The following equation (drawn from the referenced document) could be used to estimate airborne concentrations of radioisotopes that may be generated by naturally occurring resuspension processes such as surface erosion from unimproved ground surfaces

Expected Airborne Concentration = Soil Concentration x Mass Loading x Enrichment Factor x Area Correction

We have made three modifications in the equation. Justification for modifying the equation is couched in the "as low as reasonably achievable" (ALARA) concept for limiting personnel exposures to ionizing radiation. The expected airborne concentration value will be used as an initial indication of the need for protecting personnel and when protection is indicated the expected airborne concentration will determine the degree of protection required. The net result of all three modifications is to ensure that the estimated airborne concentration value is likely to be an overstatement of the actual airborne concentrations that will be encountered. Specific modifications to the equation and the assumptions inherent with the equation are described in the following paragraph.

The first modification was made to reflect that the resuspension process will be construction-type activities versus natural erosional processes. Empirical data described in "Chapter 6" indicates that multiplying the expected airborne concentration by 30 will yield airborne

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concentrations expected to be generated by construction activities conducted in soils with the same concentration of radioisotopes.

The "Enrichment Factor" and the "Area Correction" terms have been omitted from the equation. Elimination of the enrichment factor results in the assumption that all airborne particulates are of a respirable size and that each of the airborne particles is as radioactive as all other airborne particles. Elimination of the enrichment factor results in an overestimation of the airborne concentration since, as stated in the attached extract of Chapter 6, only approximately 20 percent of the airborne particles will actually be in the respirable range and only 53 percent of the total radioactivity will be contained in that 20 percent of the airborne particles. Omission of area correction results in the assumption that the area from which particulates are being generated is of an infinite size. This results in an overestimation of the airborne concentration since the initial source of particulates will be the size of a soil auger (approximately 8 inches in diameter) and the maximum source of particulates will be some small portion of the exclusion zone (a circle with an approximately 50-foot radius).

The two assumptions that are inherent to the equation are (1) that the wind blows 100 percent of the time across the source of contamination toward the receptor, and (2) the estimated airborne concentration relates to near-surface level concentrations and does not account for a decrease in the airborne concentrations attributable to the height of the worker's breathing zone above the surface level.

Accounting for the equation modifications described above, the restated equation is as follows.

$$\text{Maximum Expected Airborne Concentration} = \text{Soil Concentration} \times \text{Mass Loading} \times 30$$

Example Problem

Given: Plutonium-239 in soil at 20,455 pCi/gm

Mass Loading of 15 $\mu\text{g}/\text{m}^3$

Maximum Expected Airborne Concentration =

$$(20,455 \text{ pCi/gm})(15 \times 10^{-6} \text{ gm}/\text{m}^3)(30) = 9.20475 \text{ pCi}/\text{m}^3$$

2 Derived Air Concentration (DAC) Guides

The DACs for the following isotopes were drawn from DOE Order 5480 11, Radiation Protection for Workers, December 21, 1988 and converted to pCi/m³ through the unit conversions shown below

- Isotope DACs
 - Pu-239 - $6 \times 10^{-12} \mu\text{Ci}/\text{cm}^3 = 6 \text{ pCi}/\text{m}^3$
 - Am-241 - $2 \times 10^{-12} \mu\text{Ci}/\text{cm}^3 = 2 \text{ pCi}/\text{m}^3$
 - U-238 - $2 \times 10^{-11} \mu\text{Ci}/\text{cm}^3 = 20 \text{ pCi}/\text{m}^3$
 - U-233 & U-234 - $2 \times 10^{-11} \mu\text{Ci}/\text{cm}^3 = 20 \text{ pCi}/\text{m}^3$
 - Sr-89 - $6 \times 10^{-9} \mu\text{Ci}/\text{cm}^3 = 6 \times 10^4 \text{ pCi}/\text{m}^3$
 - Sr 90 - $2 \times 10^{-9} \mu\text{Ci}/\text{cm}^3 = 2 \times 10^3 \text{ pCi}/\text{m}^3$
- Unit Conversions
 - DAC Pu-239 = $6 \times 10^{-12} \mu\text{Ci}/\text{cm}^3 = 6 \times 10^{-18} \text{ Ci}/\text{cm}^3$
 - DAC Pu-239 = $(6 \times 10^{-18} \text{ ci}/\text{cm}^3)(1 \times 10^6 \text{ cm}^3/\text{m}^3) = 6 \times 10^{-12} \text{ Ci}/\text{m}^3 = 6 \text{ pCi}/\text{M}^3$

3 Maximum Soil Activities Used

3.1 903 Pad (IHSS No. 112)

Isotopes Found	Soil Activity Used in Calculations (pCi/g)	Estimated Airborne Activity (pCi/M ³)	DAC (pCi/M ³)
Pu-239	20,455	9.2	7
Am-241	2,273	1.02	3

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3.2 903 Pad Lip site (IHSS No. 155)

Isotopes Found	Soil Activity Used in Calculations (pCi/g)	Estimated Airborne Activity (pCi/M ³)	DAC (pCi/m ³)
Pu-239	190	0 0855	6
Am-241	0.25	0 00011	2
U-233 & U-234	0 87	0.00039	20
U-238	0.81	0 00036	20
Sr-89	1.6	0 00072	60,000
Sr-90	1.6	0 00072	2,000

3.3 All Trench Sites

Isotopes Found	Soil Activity Used in Calculations (pCi/g)	Estimated Airborne Activity (pCi/m ³)	DAC (pCi/m ³)
Pu-239	68	0 0306	6
U-238	450	0.202	20

The amount of radioactivity/gram of soil has not been determined within all trenches. However, the radioactivity/gram has been determined in three trenches, with the highest activities found in Trench T-9 (IHSS 111.6), and those values have been assigned to all trenches for the purposes of our hazard assessment.

3.4 Reactive Metals Destruction Site (IHSS No 140)

Isotopes Found	Soil Activity Used in Calculations (pCi/g)	Estimated Airborne Activity (pCi/m ³)	DAC (pCi/m ³)
Pu-239	100	0.045	6
AM-241	13	0 0059	2
U-233 & U-234	3.3	0.0015	20
U-238	2.2	0 00099	20
Sr-89	1.6	0.00072	60,000
Sr-90	1.6	0.00072	2,000

3.5 Gas Detoxification Site (IHSS No 183)

A review of the history of this IHSS does not indicate radioisotopes were disposed of here.

3.6 Mound Site (IHSS No. 113)

Isotopes Found	Soil Activity Used in Calculations (pCi/g)	Estimated Airborne Activity (pCi/m ³)	DAC (pCi/m ³)
See Note	51	0 023	2

Note: A review of the site history indicates that a soil activity of 51 pCi/g of an unspecified radioisotope has been noted. We have calculated the maximum expected airborne activity and compared it to the most restrictive DAC (Am-241) for the isotopes found at Rocky Flats Plant.

3.7 Oil Burn Pit No. 2 (IHSS No. 153)

No radioanalytical results exist for soil boring samples for this site. However, approximately the top 5 feet of soil has been removed since the site was last used. Therefore, we do not consider this site to be a source of potential inhalation hazards from radioisotopes.

3.8 Pallet Burn Pit (IHSS No. 154)

A review of the history of this site does not indicate radioisotopes were disposed of here.

3.9 East Spray Field Center Area (IHSS No. 216.2), South Area (IHSS No. 216.3), and Outlying Areas (non-IHSS sites within OU2)

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Isotopes Found	Soil Activity Used in Calculations (pCi/g)	Estimated Airborne Activity (pCi/m ³)	DAC (pCi/m ³)
Pu-239	11.34	0.005	6

Note: The maximum amount of surficial soil activity found has been assigned to all the above sites.

6. RADIOLOGICAL ASSESSMENT - ROCKY FLATS PLANT

[Reprinted With Minor Changes from Response to Comments -
EPA 520/4-78-010]

6.1 INTRODUCTION

This chapter presents an analysis of the potential hazards to individuals in the general population as a result of transuranium element contamination in the environs of the USDOE Rocky Flats Plant. It is intended primarily to serve as an illustrative example of how to carry out a comprehensive environmental assessment, and does not represent an evaluation of potential health hazards. Analysis is limited to data for the period 1970-77, when public concern about possible health hazards was greatest. The various pathways by which exposures might occur under present and projected land usages are examined and interpreted in terms of ambient levels of contamination.

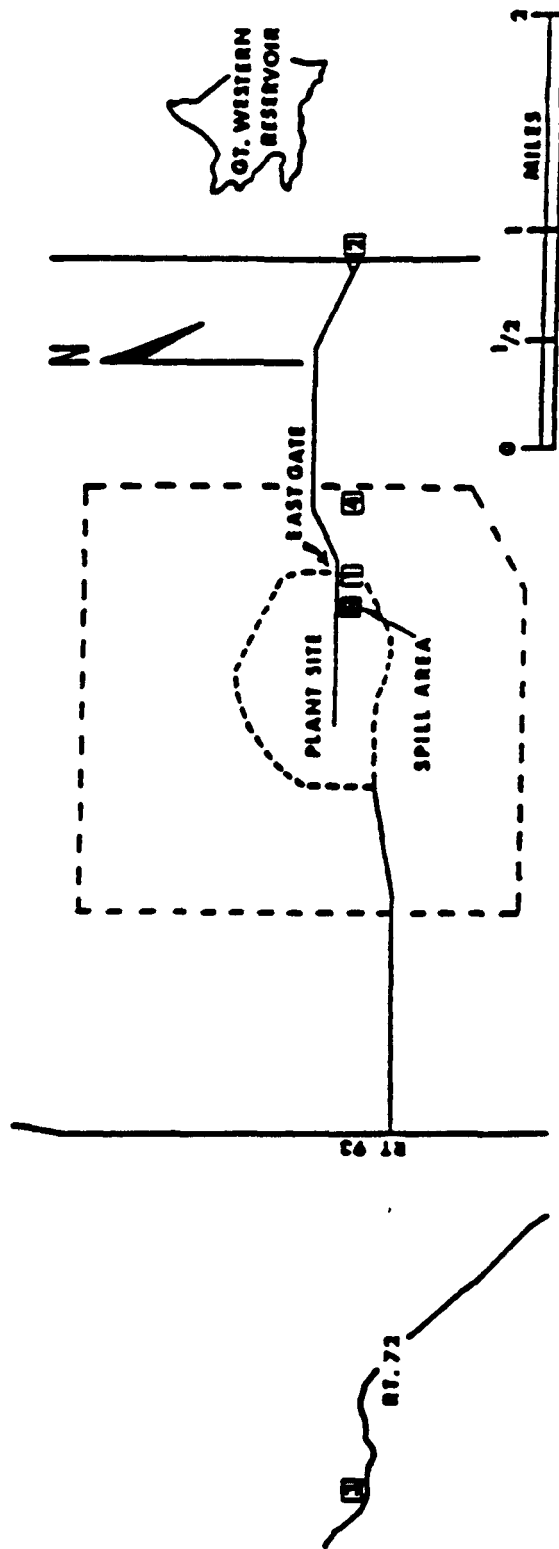
6.2 INHALATION PATHWAY

6.2.1 AMBIENT AIR CONCENTRATIONS

Under normal operating conditions, minute quantities of plutonium and other radionuclides have been released to the atmosphere from the Rocky Flats Plant. These releases originated from the plant's ventilation and filtration system. Measurements of airborne radioactivity in the vicinity of Rocky Flats and the neighboring communities are made on a continuous basis. In addition to monitoring the effluent air from production and research facilities, the Rocky Flats facility maintains a system of high-volume ambient air samplers within the plant boundary, at off-site locations in the immediate vicinity of the plant, and in several communities nearby. Altogether the system comprises 21 air samplers operating continuously within and on the perimeter of the Rocky Flats security area, and another

25 samplers located at various distances and directions from the plant. The data from this network are reported on a monthly basis to the Rocky Flats Area Office of the Department of Energy (DOE), the Division of Occupational and Radiological Health of the Colorado Department of Health, the Denver Regional Office of the EPA, the Health Departments of Boulder and Jefferson Counties, and city officials in several communities near the plant.

In addition to the surveillance network maintained by the Rocky Flats Plant, the Health and Safety Laboratory (HASL) of DOE conducted a program of continuous air sampling for plutonium at the Plant since June 1970 in response to the discovery of elevated levels of plutonium found in soils at location which were then off-site. The HASL network consisted of four sampling locations (Figure 6-1), three of which were downwind (east) from the original location of the oil drum storage site and the fourth air sampler was located off-site and upwind from the Rocky Flats Plant. Air concentration data in attocuries of Pu-239 per cubic meter of air (aCi/m^3), as reported by this network on a monthly basis from June 1970 to March 1976, are given in Table 6-1. A significant downward trend with time in the level of plutonium in air at the stations downwind from the plant can be seen. It has been suggested by HASL that this downward trend is attributable to the weathering of the contaminated soil in the on-site vicinity of the original oil drum storage site. This weathering may be due to the movement of the plutonium from the surface down into the soil, as well as changes in the characteristics of the plutonium remaining on the surface. In addition to showing a decrease with time the data indicate a decrease in concentration with increasing distance downwind from the site of the original spill area. Based upon air and soil sampling, as well as the direction of the prevailing winds around Rocky Flats, HASL concluded in 1972 (2) that the original spill area was the primary source of plutonium in the Rocky Flats environment.



MAP OF ROCKY FLATS PLANT AND VICINITY
 INDICATING CONTINUOUS AIR SAMPLING SITES (1).

FIGURE 6-1

TABLE 6-1
 MONTHLY AVERAGE AIR CONCENTRATIONS OF Pu-239
 AT ROCKY FLATS PLANT
 (Attocuries /Cubic Meter)

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
SITE #1												
1970	--	--	--	--	--	1990 00	1250 00	790 00	850.00	693 00	2260 00	962.00
1971	1960 00	--	7140 00	9730.00	4920 00	3800 00	2980 00	3530.00	4040.00	5770 00	5770 00	3160 00
1972	5430.00	1670.00	4610.00	1460.00	2080 00	6610 00	4720 00	1380 00	--	1620 00	498 00	1860 00
1973	1160 00	3640 00	2520 00	612.00	1780 00	3040 00	2920 00	3320 00	1050.00	2010 00	1810 00	1690 00
1974	402 00	802 00	891 00	1810.00	3060 00	5470 00	2670 00	3330 00	1120 00	407 00	580 00	643 00
1975	1260 00	1360 00	1780 00	2180.00	2190 00	1160 00	567 00	426 00	179 00	--	1220 00	655.00
1976	680 00	1240 00	864 00	--	--	--	--	--	--	--	--	--
SITE #2												
1972	--	--	--	--	--	--	98 90	55 50	119.00	609 00	48 50	45 20
1973	37 80	57.70	55 80	716 00 ^c	51.80	57 70	92 10	65 00	152.00	31 50	25 20	76 30
1974	16 80	23.20	462 00 ^c	135.00	176 00	140 00	78 70	58 10	34.20	24 00	29 20	43.70
1975	141.00	34.70	56 80	39.70	--	--	27 40	14.00	9.98	--	10 60	16.40
1976	12.20	23.10	14 40	--	--	--	--	--	--	--	--	--
SITE #3												
1972	--	--	--	--	--	--	--	--	--	21 90	18 50	25 60
1973	18.40	41.70 ^b	24 20	24.00	40 40	42 00	25 80	25 70	38.20	21 50	11 00	16.90
1974	21.70	39 10	163 00 ^c	283.00 ^c	--	--	--	--	--	--	--	--
SITE #4												
1974	--	--	--	--	1460 00	738 00	1430 00	222.00	199.00	395.00	1240 00	710.00
1975	288.00	399.00	1850.00	254.00	139.00	684.00	118 00	146 00	72.20	189 00	188 00	128 00
1976	184.00	303.00	72 60	236.00	109.00	319.00	98 20	63 10	--	--	--	--

-- NO DATA
 Errors are less than 20% except:
 a -error between 20% and 100%
 b -error greater than 100%
 c -suspect, omitted from average

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The levels of airborne plutonium at the downwind edge of the buffer zone (Indiana Street) were approximately the same level as reported at the monitoring station upwind from the plant. Although these levels were about twice that expected from background radioactivity in the Rocky Flats area, the effect of the spill area upon the off-site environment has been much reduced from earlier levels.

Comparison of the HASL data for 1976 for the Indiana Street location (site 2) with the 1975 data reported by the Rocky Flats Plant (Table 6-2) for the same general area shows the two networks to agree within a factor of about 2. The values reported by HASL range between 12 to 23 aCi/m³, while Rocky Flats reported an average of 37 aCi/m³.

6.2.2 INHALATION DOSES DUE TO ON-SITE CONTAMINATION

An assessment can be made of the doses received through inhalation by individuals residing off-site at the time the measurements were made, based upon the considerable amount of air monitoring data available for the Rocky Flats Plant. In carrying out this assessment; a deliberate effort has been made to choose assumptions which are most likely to result in an overestimate of dose. These are:

- 1) Inhaled plutonium is considered to be in an insoluble form. (chemical solubility of an aerosol determines its residence time in the lung with insoluble compounds being retained the longest.)

- 2) The plutonium aerosol is assumed to have a lognormal distribution with an activity median aerodynamic diameter (AMAD) of 1 micrometer. (According to the ICRP (3) this implies that approximately 25% of the aerosol will be deposited in the pulmonary compartment of the lung. HASL (4) has reported 25% of

TABLE 6-2
 PLUTONIUM IN AMBIENT AIR NEAR ROCKY FLATS PLANT (1976)
 [Air Concentration in Attocuries/Cubic Meter]
 Distances = 3 to 6 Kilometers

Station	Number of Samples Taken	Less Than Detectable	Volume (cubic meters)	Concentration	
				C _{maximum}	C _{average^a}
S-31	12	1	461,547.0	0.144	<0.032 ± 96%
S-32	12	1	543,346.0	0.134	<0.035 ± 96%
S-33	12	1	531,886.0	0.097	<0.034 ± 95%
S-34	3	1	118,243.0	0.176	<0.037 ± 550%
S-35	3	0	119,322.0	0.116	0.027 ± 538%
S-36	2	0	57,286.0	0.012	0.012 ± 1734%
S-37	12	0	525,181.0	0.198	0.056 ± 93%
S-38	10	0	460,089.0	0.097	0.027 ± 108%
S-39	12	1	502,129.0	0.102	<0.026 ± 97%
S-40	12	0	486,876.0	0.198	0.054 ± 92%
S-41	12	1	472,698.0	0.136	<0.033 ± 99%
S-42	12	1	416,244.0	0.137	<0.037 ± 96%
S-43	11	1	360,818.0	0.185	<0.056 ± 105%
S-44	12	1	429,709.0	0.094	<0.029 ± 103%
Summary	137	9	5,485,374.0	0.198	-
Volume-Weighted Average					<0.037 ± 29%

a. Volume-weighted average.

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the airborne activity being in the respirable range around Rocky Flats, while Sehmel (5) has reported a 20% respirable fraction.

3) The individual is considered to be exposed continuously for 10 years at the currently observed air concentration. (No further reduction in airborne activity as a result of weathering or remedial actions is assumed)

4) All plutonium was assumed to contribute to the dose, with no correction being made for ambient background levels of plutonium.

The PAID code developed by EPA (6) was used to calculate the annual dose rate. Tables 6-3 and 6-4 have been generated by the PAID code and relate years of exposure to the resultant dose rate for various organs. Values in the tables are normalized to an aerosol concentration of 1.0 femtocurie per cubic meter of air (fCi/m^3) with a $1 \mu\text{m}$ AMAD.

6.2.3 INDIANA STREET LOCATION

Indiana Street is the nearest location to the Rocky Flats Plant where an individual in the general population could live and be exposed as a result of transuranium contamination originating from the Plant. This location is in the downwind direction of the prevailing winds that blow across the Rocky Flats Plant (7) and, therefore, it represents a worst case for offsite exposure.

From Figure 6-2 it can be seen that stations 5-35, 5-36, 5-37, 5-38, and 5-39 are located along Indiana Street. The station reporting the highest annual average for 1975 was 5-37 with $0.056 \text{ fCi}/\text{m}^3$ (Table 6-2). Assuming this level to continue for the next 70 years, the 70th year dose rates to lung and bone can be calculated.

TABLE 6-3
 ANNUAL DOSE RATE TO VARIOUS LUNG COMPARTMENTS
 FROM CHRONIC EXPOSURE TO PLUTONIUM-239 AEROSOLS

Concentration: 1.0 fci/m³ Particle AMAD: 0.05, 1.0 and 5.0 Microns

Duration of Exposure (Years)	Pulmonary mrad/yr. x 10 ⁻¹			Tracheobronchial mrad/yr. x 10 ⁻¹			Nasopharyngeal mrad/yr. x 10 ⁻⁶		
	0.05u	1.0u	5.0u	0.05u	1.0u	5.0u	0.05u	1.0u	5.0u
1	3.9	1.5	.7	2.7	1.1	6.1	.04	11.	30.
5	9.1	3.5	1.7	3.7	1.5	7.9	.04	11.	30.
10	9.8	3.8	1.8	3.8	1.6	8.1	.04	11.	30.
70	9.9	3.8	1.8	3.8	1.6	8.1	.04	11.	30.

TABLE 6-4

ANNUAL DOSE RATES TO VARIOUS ORGANS FROM CHRONIC INHALATION OF TRANSURANIUM RADIONUCLIDES (In Millirad/Year)

Aerosol AMAD: 1 μ m Concentration: 1 fci/m³ $f_1=10^{-3}$

Nuclide: Pu-239		Nuclide: Pu-241/Am-241				
Duration of Exposure		Liver	Skeletal	Bone Red Marrow	Endosteal	
1 year	1.0 E-3	5.0 E-4	6.6 E-3	4.0 E-4	6.6 E-3	
5 years	1.0 E-3	6.5 E-3	6.6 E-3	6.2 E-3	6.6 E-3	
10 years	5.2 E-3	1.9 E-3	2.5 E-1	1.0 E-3	2.5 E-1	
15 years	0.9 E-2	3.0 E-3	4.5 E-1	3.2 E-2	4.5 E-1	
20 years	1.3 E-1	4.9 E-3	6.7 E-2	4.7 E-2	6.7 E-2	
30 years	1.9 E-1	7.0 E-3	1.0 E-0	7.4 E-2	1.0 E-0	
40 years	2.4 E-1	1.1 E-1	1.5 E-0	1.1 E-1	1.5 E-0	
50 years	2.9 E-1	1.3 E-1	1.7 E-0	1.2 E-1	1.7 E-0	
70 years	3.6 E-1	1.7 E-1	2.3 E-0	1.6 E-1	2.3 E-0	
Nuclide: Am-241		Nuclide: Cm-244/Pu-240				
Duration of Exposure		Liver	Skeletal	Bone Red Marrow	Endosteal	
1 year	1.5 E-3	5.0 E-4	6.0 E-4	1.0 E-3	6.0 E-4	
5 years	1.5 E-3	7.0 E-3	1.6 E-3	1.0 E-3	1.6 E-3	
10 years	3.5 E-3	2.1 E-3	1.7 E-2	1.5 E-3	1.7 E-2	
15 years	9.5 E-3	3.6 E-3	2.0 E-2	2.6 E-3	2.0 E-2	
20 years	1.3 E-1	5.2 E-3	3.7 E-2	3.4 E-3	3.7 E-2	
30 years	2.0 E-1	8.3 E-3	4.9 E-2	4.5 E-3	4.9 E-2	
40 years	2.6 E-1	1.1 E-1	5.7 E-2	5.3 E-3	5.7 E-2	
50 years	3.0 E-1	1.4 E-1	6.3 E-2	5.8 E-3	6.3 E-2	
70 years	3.7 E-1	1.6 E-1	6.8 E-2	6.3 E-3	6.8 E-2	

• Alpha dose only - 70th year beta dose rates liver - 0.11 uRAD
bone - 0.049 uRAD



- FIGURE 6-2**

As shown in Table 6-3, an air concentration of 1.0 fCi/m^3 for $1 \mu\text{m}$ AMAD aerosols of Pu-239 would produce a 70th year dose rate to the pulmonary compartment of 0.38 mrad/yr ; therefore, proportionally, a concentration of 0.056 fCi/m^2 (5-37) will produce a 70th yr dose rate of 0.02 mrad/yr . The bone dose rate associated with this level of Pu-239 according to Table 6-4 will be 0.009 mrad/yr in the 70th year.

Data on the air concentration of Am-241 have been reported by HASL (7) for the years 1970 through 1974. These data show the americium levels, measured at the perimeter fence of the Plant, to be approximately 11% of the Pu-239 levels. HASL projected that the Am-241 activity level will reach its maximum value arising from the decay of Pu-241 in the year 2033 at which time it will amount to 18% of the Pu-239 activity. For the calculation of the dose rate from Am-241, it is assumed that Am-241 is at the maximum of 18% of the Pu-239. The 70th year dose rate corresponding to a concentration of 1 fCi/m^3 of Am-241 is 0.4 mrad/yr ; proportionally, an air concentration of $0.18 \times 0.056 \text{ fCi/m}^3$ would produce 0.004 mrad/yr to the pulmonary compartment. The associated bone dose would be approximately 0.002 mrad/yr .

Based upon these calculations, the total pulmonary dose rate after 70 years of exposure for an individual living along Indiana Street would be 0.024 mrad/yr , while the associated bone dose would be 0.01 mrad/yr . Individuals living further away from the Rocky Flats Plant should receive even lower doses than these due to the lower air concentrations reported for the nearby communities.

6.2.4 INHALATION DOSES DUE TO OFF-SITE CONTAMINATION

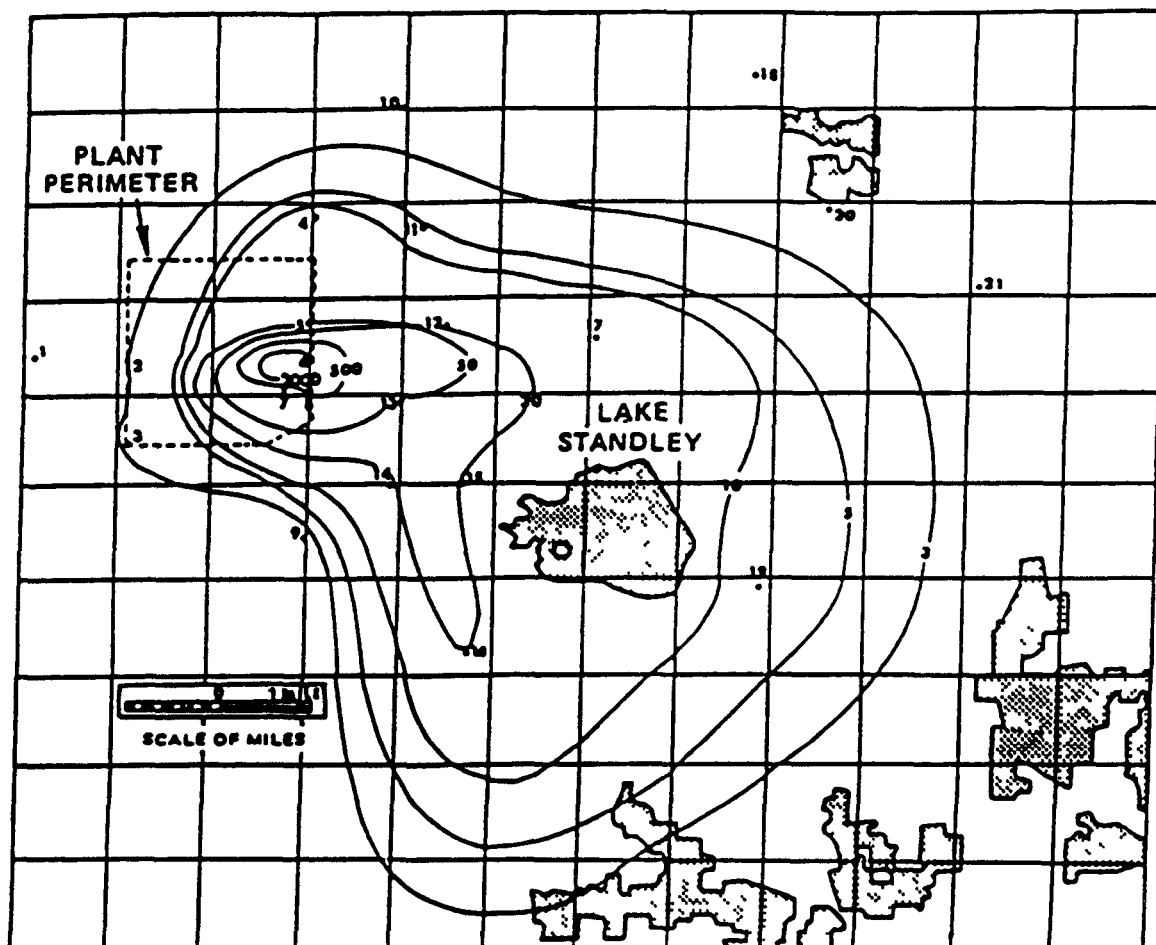
A complete assessment of the inhalation pathway for the Rocky Flats vicinity must consider the potential hazard from the low levels of contaminated soil which already exist off-site.

Questions have been raised as to the effect of this material in producing localized exposures which are not necessarily reflected in the data obtained through the air monitoring network around Rocky Flats. These inhalation exposures can arise through various mechanisms including: wind resuspension of contaminated soil, vehicular and mechanical disturbances of soil, accumulation and resuspension of dust within the home, as well as the resuspension of contaminated soil attached to clothing. The following analysis will attempt to investigate these exposure mechanisms and assess their potential impact.

6.2.5 WIND RESUSPENSION

Figure 6-3 shows the off-site soil contamination contours reported by HASL in 1970 (2). Soil sampling programs in 1975 (8) showed that these contours had not changed significantly from the 1970 report. The highest off-site contour shown by the HASL data was 0.05 uCi/m^2 . These contours were developed based upon an inventory sample to a depth of 20 centimeters. What is important in assessing the resuspension of soil, however, is only the material existing near the surface. Based upon the HASL soil depth profiles, Anspaugh (9) stated that approximately 20% of the total activity is contained within the first centimeter. Therefore, the highest contour value of 0.05 uCi/m^2 would correspond to 0.01 uCi/m^2 when corrected for a 1 cm. depth. On a mass basis, 0.01 uCi/m^2 is equivalent to approximately 2 disintegrations per minute per gram of soil, i.e., 2 DPM/gm. The offsite area bounded by this contour is approximately two square kilometers and soil within that area would be projected to be at or above 2 DPM/gm. Beyond this area, off-site soil will generally be below this value.

This review uses the mass loading approach as an indicator of the general resuspension by wind over large land areas. Because of technical shortcomings identified with the mass



ROCKY FLATS
PLUTONIUM-239 CONTOURS mCi/km^2

FIGURE 6-3

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loading approach (10), the concept has been modified by an area correction factor to correct for small areas of contamination and with an enrichment factor to reflect a nonuniform distribution of radioactivity with soil particle size. This latter modification is particularly important because transuranium activity associated with soil particles within the respirable range is a greater hazard than it would be if associated with the larger particle sizes.

The mass loading approach assumes the loading of the air with particulates to be an index of resuspension and derives the airborne concentration of a specific radionuclide by a comparison with its concentration on the adjacent surface (11). Specifically,

$$\text{Air Concentration (fCi/m}^3\text{)} = \frac{\text{Soil Concentration (uCi/m}^2\text{)}}{\text{Mass Loading (ug/m}^3\text{)} \times \text{U.C.}}$$

where U.C. is the units conversion factor based upon the depth of sampling and the soil density.

Airborne particulate mass loading is one of the criteria for clean air standards and measurements are widely available for urban and nonurban locations through the National Air Surveillance Network (NASN). The data recorded at nonurban stations are a better indicator of the levels of resuspended material than are urban measurements. In general, annual mean mass concentrations of airborne particulate material at the nonurban stations range from 5-50 micrograms per cubic meter (Figure 6-4); the mean arithmetic average for 1966 of all 30 nonurban NASN stations was 38 ug/m³ (11). From Figure 6-4 an estimate can be made of the average mass loading for the general area in which Rocky Flats is located. It would appear that 15 ug/m is reasonably representative of this area on an annual basis.

Simple application of the mass loading approach without consideration of the activity distribution as a function of



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particle size is not appropriate, however, since that would imply a uniform distribution of activity with particle size as well as a uniform resuspension of all particle sizes. This has not been found to be the case at Rocky Flats (12) or at other plutonium contaminated sites (13).

In addition, an important consideration in assessing the potential exposure due to contaminated soil is the amount of activity associated with particles within the respirable size range. Johnson (14) has suggested that sampling of only those particles in a soil sample which are within the inhalable size range (generally $< 10 \mu\text{m}$) would give the best measure of risk to the public health around Rocky Flats. However, the weight fraction of particles in the less than $10 \mu\text{m}$ range is small in most soils, and sampling, separation, and analysis techniques are correspondingly more difficult and inaccurate. There is also considerable evidence that some of the larger particles really consist of aggregates and are relatively easily broken down into smaller ones, so that an instantaneous measurement of a single size range may not give a good picture of long-term trends. Also a substantial contribution to other possible pathways (e.g. ingestion) may be via larger particle sizes and measurement of the contribution of only the inhalable fraction would not provide all the information that is required.

6.2.5.1 ENRICHMENT FACTOR

The "Enrichment Factor" is intended to 1) give a mathematical view of the different fractions of the total radioactivity associated with particles of different size ranges, and 2) address the problem of the nonuniform resuspension of particle sizes.

The inhalable fraction of the soil is weighted by considering the relative distribution of activity and soil mass

as a function of particle size for representative samples of soil. To accomplish this, the sample of contaminated soil is segregated into "n" size increments and the activity and mass contained within each size increment is determined. The factor g_i is then defined as the ratio of the fraction of the total activity contained within an increment "i" to the fraction of the total mass contained within that increment. A value greater than 1 for g_i implies an enrichment of activity in relation to mass, while a value less than 1 indicates a dilution of the activity with respect to mass.

The nonuniform resuspension of particle sizes is also considered by measuring the mass loading as a function of particle size. The fraction of the airborne mass contained within each size increment "i" is then calculated and designated as f_i . The factors of f_i and g_i are then incorporated into the mass loading formulation for each size increment as follows:

$$\text{Air Conc}_i = \text{Air Mass Loading} \times f_i \times \text{Soil Conc} \times g_i$$

Summation over all the size increments results in the total air concentration:

$$\text{Air Conc} = \text{Air Mass Loading} \times \text{Soil Conc} \times \sum f_i g_i$$

The term $\sum f_i g_i$ weights the contribution of plutonium from each soil size fraction to the total resuspended material, thereby taking into account both the nonuniform resuspension of particles sizes as well as the nonhomogeneous distribution of activity with particle size.

Data on the distribution of plutonium with soil particle size has been obtained (12) for the vicinity around Rocky Flats (Table 6-5). The ratio, g_i has been calculated for each size increment and indicates an enrichment of activity to mass associated with soil particles within the respirable size range. To obtain f_i , the data obtained by Chepil (15) for fields

TABLE 6-5

EXPERIMENTAL DATA FOR WEIGHT AND ACTIVITY FRACTIONS
 FOR SOILS IN THE ENVIRONS OF THE ROCKY FLATS PLANT
 [Sampling and Analysis by US Environmental Protection Agency]

Sample	Size Increment (µm)	Wgt Fract	Act Fract	B ₁	f ₁	f f ₁ B ₁
RF 1A	2000-105	.62	.07	.12	-	-
	105-10	.18	.40	2.21	.7	-
	<10	.20	.53	2.65	.3	2.34
RF 1B	2000-105	.63	.39	.63	-	-
	105-10	.17	.06	.34	.7	-
	<10	.20	.55	2.74	.3	1.06
RF 1C	2000-105	.64	.43	.68	-	-
	105-10	.16	.07	.46	.7	-
	<10	.20	.49	2.47	.3	1.06
RF 2A	2000-105	.46	.13	.28	-	-
	105-10	.34	.37	1.10	.7	-
	<10	.20	.50	2.48	.3	1.51
					av.	1.49

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undergoing wind erosion in Colorado and Kansas were used. The results of his findings have been conveniently plotted by Slinn (16) and reproduced as Figure 6-5. Comparison of Chepil's data with another study substantiates the applicability to the Rocky Flats situation. Chepil found 30% of the airborne mass to be below 10 μm versus a study by Willeke (17) in an area outside Denver where approximately 33% of the measured airborne mass was below 10 μm . Values for f_i used in this analysis are included in Table 6-5.

6.2.5.2 CORRECTION FOR AREA SIZE

Use of the mass loading approach implies that the air concentration is at equilibrium with the ground surface, i.e., a steady state situation exists in which the amount of material coming up from the surface is balanced by the rate at which material is depositing back onto the surface. In the strictest sense this limit can only be achieved for source areas approaching infinite dimensions. For sources of finite dimensions, a correction must be applied for area size.

Although many techniques are presently under development to calculate the air concentration arising from an area source, no generally accepted method has yet been identified. Usually, these approaches make use of a standard diffusion equation, modified to handle area sources. One such equation is the Sutton-Chamberlain diffusion equation:

$$\frac{X}{Q_A} = \frac{1}{V_d} \left[\exp\left(-\frac{4 V_d D_1^{n2}}{\pi^{1/2} C_z n u}\right) - \exp\left(-\frac{4 V_d D_2^{n2}}{\pi^{1/2} C_z n u}\right) \right]$$

where X is the air concentration, Ci/m

Q is the amount of activity resuspended per unit area, per unit time, $\text{Ci}/\text{m}^2 \text{ sec}$

V_d is the particle deposition velocity, m/sec

D_1 and D_2 are the distances from the receptor to the nearest and furthest edges respectively of the source area

u is average wind speed, m/sec

C_z and n are Sutton parameters for meteorological conditions.

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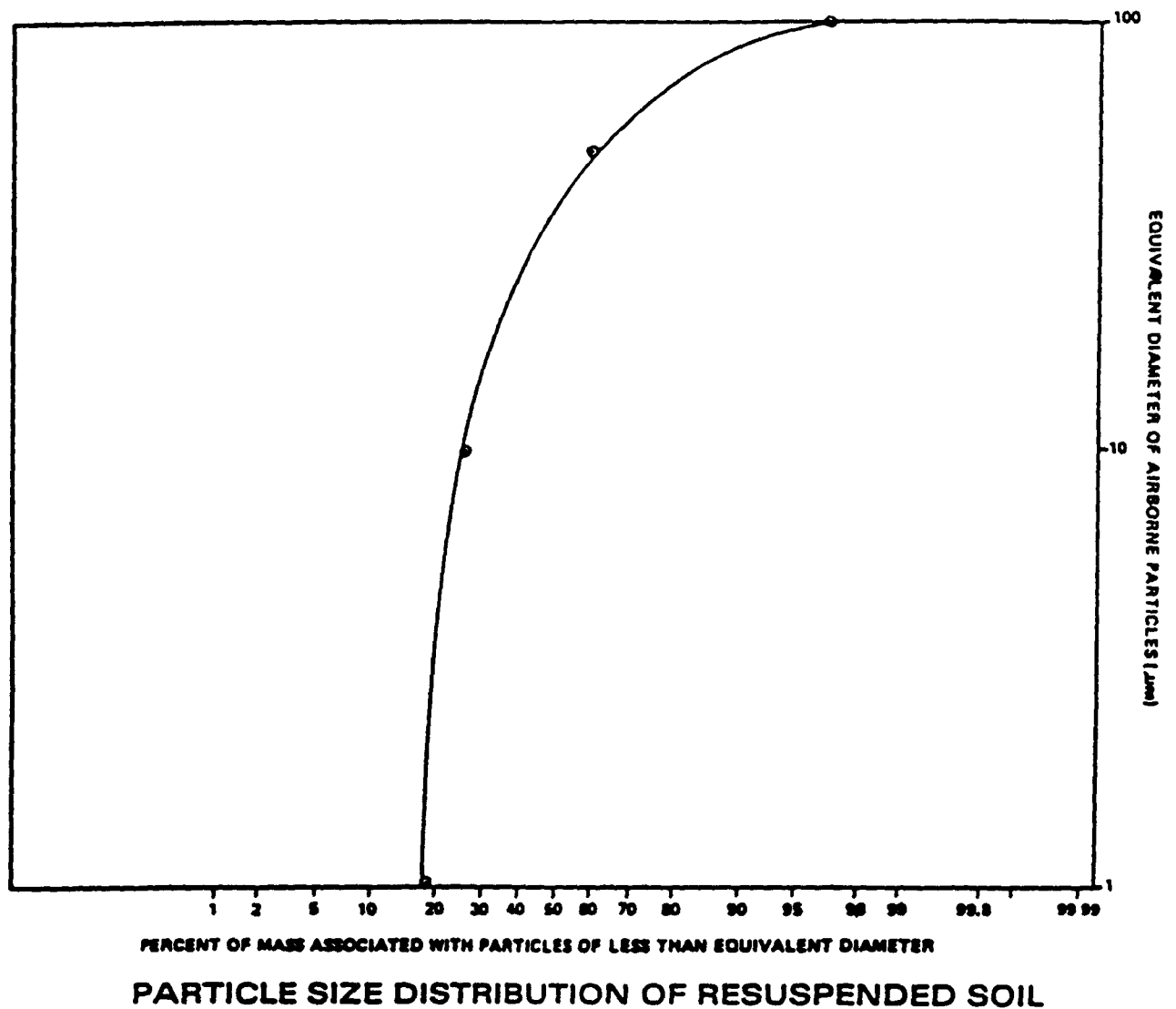


FIGURE 6-5

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For source areas approaching infinite depth, $D_2 \rightarrow \infty$ and the above equation becomes

$$\frac{X}{Q_A} = \frac{1}{V_d}$$

Therefore, the correction term to be applied for areas of finite size is

$$1 - \exp\left(-\frac{4 V_d D_2^{n/2}}{\pi^{1/2} C_z n u}\right)$$

The area under consideration in this analysis has been described earlier. It is bounded by Indiana Street and the 0.05 Ci/m² isopleth (Figure 6-3) with a width in the downwind direction of approximately 1 kilometer. This is the most highly contaminated off-site area and includes sites of projected residential development. The meteorology for the Rocky Flats area has been described (8) to have neutral stability at least 50% of the time with a mean wind speed of 4.2 m/sec in 1975. Healy (18) has suggested values for the parameters required for the situation of neutral stability: $C_z = 0.1$ and $n = 0.25$, while the ratio V_d/u , which depends upon the surface roughness, ranges between 0.003 and 0.008 for grassland. A value of 0.005 will be assumed. Therefore, the correction factor for the area under consideration is 0.66.

6.2.6 AVERAGE AIR CONCENTRATION DUE TO WIND RESUSPENSION

The average soil concentration for the area is not known, but it would be somewhere between 0.05 uCi/m² and the next higher isopleth of 0.5 uCi/m². For calculational purposes, 0.25 uCi/m² will be assumed or approximately 10 DPM/g (based upon 20% of the radioactivity within the first centimeter). By using the parameters developed in the previous sections for the Rocky Flats

area, one can estimate the average air concentration due to wind resuspension:

$$\text{Air Conc} = \text{Mass Loading} \times \text{Soil Conc} \times \text{Enrichment Factor} \\ \times \text{Area Correction Factor}$$

$$\begin{aligned} \text{Air Concentration} &= 15 \text{ ug/m}^3 \times 10 \text{ DPM/g} \times 10^{-6} \text{ g/ug} \\ &\times \text{Ci}/2.22 \times 10^{12} \text{ DPM} \\ &= 0.066 \text{ fCi/m}^3 \end{aligned}$$

This calculated value of 0.066 fCi/m agrees within a factor of 2 with the data obtained for the sampling stations along Indiana Street.

Inherent in the above calculation were some conservative assumptions. First of all, the wind was assumed to be blowing 100% of the time across the contaminated area in the direction of the receptor. In reality, the reported (8) wind rose for Rocky Flats indicates that the wind blows from the westerly direction only about 50% of the time; the remaining time it will be blowing from the direction of less contaminated land and, therefore, less radioactivity would be available for resuspension. Second, in deriving the area correction factor the effect of breathing height was ignored with the ground level concentration being calculated. This is a conservative assumption since the airborne concentration will decrease as a function of the height above the ground. Although such refinements may be incorporated in the calculation, the results represent a conservative approach to deriving the dose rates to potentially exposed persons.

6.2.7 RESUSPENSION OF SOIL BY MECHANICAL DISTURBANCES

The use of land contaminated with transuranium elements in the vicinity of Rocky Flats for agricultural or building purposes can result in localized resuspension and presents a potential inhalation hazard to individuals in the immediate vicinity of the

operation. In the vicinity of Rocky Flats, there is some farming of wheat and the raising of corn for livestock feed. Future development of the land for residential purposes is also being advocated. Although only a limited amount of experimental data are currently available to base an assessment of the inhalation hazard from such activities, some conclusions and recommendations can be made.

In assessing the agricultural situation, data obtained by Milham (19) have been utilized. In that study, a field contaminated with plutonium near the Savannah River Facility was subjected to various plowing and seeding activities associated with planting wheat. The increase in the airborne activity above that from normal wind resuspension was monitored at the location of the tractor operator and at the downwind edge of the field during the various activities. An average increase of a factor of 30 was observed in the level of resuspended plutonium at the location of the tractor operator and an increase of a factor of 5 at the edge of the field. Based upon these observations, the average air concentration for the year can be calculated for these two locations, assuming that the field is cultivated 30 days of the year for 8 hours per day. Again the area under consideration will be that area of highest off-site contamination described earlier with an average soil contamination level of 10 DPM/g. In the previous discussion of wind resuspension, this level of soil activity produced an air concentration of 0.066 fCi/m³. From Milham's data, this activity level would increase to 2.0 fCi/m³ at the location of the tractor operator and to 0.33 fCi/m³ at the edge of the field during the agricultural operations. The annual average concentration at the tractor location is then:

$$2 \text{ fCi/m}^3 \times 8/24 \text{ hr} \times 30/360 \text{ d} + 0.33 \text{ fCi/m}^3 \times 330/360 \text{ d} \\ + 0.066 \text{ fCi/m}^3 \times 16/24 \text{ hr} \times 30/360 \text{ d} = 0.07 \text{ fCi/m}^3$$

When these annual Pu-239 concentrations are compared to the value of 2.6 fCi/m^3 which was calculated by the PAID code to correspond with a dose rate of 1 mrad/year to the lung, one can conclude that agricultural operations in the area of Rocky Flats would produce activity levels well below levels of concern. In addition, after the first plowing cycle, the surface concentration should be diluted by mixing with soil from below the surface and subsequent plowings would produce air concentration lower than that of the first year.

One can also make projections for building activities based upon the agricultural situation examined above. There does not appear to be any reason why building activities, such as excavation and grading, should produce higher instantaneous air concentrations than those observed during agricultural plowing and, therefore, should not present a more restrictive situation.

6.2.8 RESUSPENSION OF DUST WITHIN THE HOME

The total amount of soil continuously in the home is not known but an assumption of 10 g/m^2 has been made (20). This amounts to about 3 lbs of soil in a modest 1500 square foot house. Because the floors are harder and smoother than outside surfaces, the resuspension from these surfaces will be higher. Resuspension factors of $10^{-6}/\text{m}$ have been used in the past to predict exposures in the work place and studies of PuO_2 deposited on indoor surfaces have been consistent with such a value (21).

The following exposure situation is postulated: the individual is exposed to contaminated dust in the home for 24 hrs/day, 7 days/week, for 70 years. The dust in the home has the same activity/gram as outside soil and has an areal distribution within the home of 10 g/m^2 . The air concentration resulting from resuspended dust at 10 DPM/g would be:

$$10 \text{ DPM/g} \times \text{Ci}/2.22 \times 10^{12} \text{ DPM} \times 10 \text{ g/m}^2 \times 10^{-6}/\text{m} = 0.045 \text{ fCi/m}^3$$

ATTACHMENT F

**ESTIMATING AIRBORNE CONCENTRATIONS
OF VOLATILE AND SEMIVOLATILE ORGANIC
COMPOUNDS FROM GROUNDWATER**

- 1 Raoult's Law was used to calculate the maximum airborne concentration of the nine nonradioactive compounds found in groundwater at concentrations greater than potential chemical-specific applicable or relevant and appropriate requirements (ARARs) (extracted from Table 2-12, Phase II RFI/RIFS Work Plan (Alluvial)).

Raoult's Law

$$\text{Mole Fraction} = \frac{\frac{\text{Mass}}{\text{MW}_c}}{\left[\left(\frac{\text{Mass}}{\text{MW}_c} \right) + \left(\frac{1 - \text{Mass}}{\text{MW}_w} \right) \right]}$$

Mass (in grams)	=	(mg/l of contaminant)(1 x 10 ⁻⁶)
MW _c	=	molecular weight of contaminant
MW _w	=	molecular weight of water
p (mmHg)	=	(V _c)(mole fraction)
V _c	=	Vapor pressure of contaminant at temperature of fluids in question

$$\text{ppm of contaminant in air above fluid surface} = \left(\frac{P}{P_a} \right) (1 \times 10^6)$$

P_a = air pressure in mmHg

2 Example Problem

Given:

- 1100 µg/l of carbon tetrachloride, therefore Mass = (1100 x 10⁻³ mg/l)(1 x 10⁻⁶)
 = 1.1 x 10⁻⁶ gm/gm

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- $MW_c = 153.8$
- $MW_w = 18$
- $V_c = 91 \text{ mmHg at } 20^\circ \text{ C}$
- $P_a = 700 \text{ mmHg}$

$$\text{Mole Fraction} = \frac{\left(\frac{1.1 \times 10^{-6}}{153.8} \right)}{\left(\frac{1.1 \times 10^{-6}}{153.8} \right) + \left(\frac{1 - 1.1 \times 10^{-6}}{18} \right)} = 1.287388 \times 10^{-7}$$

$$P = (91)(1.287388 \times 10^{-7}) = 1.1715123 \times 10^{-5}$$

$$\text{ppm} = \left(\frac{1.171523 \times 10^{-5}}{700} \right) (1 \times 10^6) = 1.673604 \times 10^{-2} = 0.017 \text{ ppm of } \text{C}$$

Carbon tetrachloride

3. The following compounds (extracted from Table 2-12, Phase II RFI/RI Work Plan (Alluvial) have been found in groundwater at concentrations greater than potential chemical-specific ARARs. The estimated airborne concentration is based upon Raoult's Law, and the 8-hour time-weighted average (TWA) permissible exposure limits (PELs) have been drawn from Occupational Safety and Health Administration's 1989 amended PELs.

Compound	Maximum Concentration In Groundwater $\mu\text{g/l}$	Estimated Airborne Concentration (ppm)	8-hr TWA PEL (ppm)
Carbon Tetrachloride (CAS-56-23-25)	1,100	0.034	2
Vinyl Chloride (CAS 75-01-4)	520	0.55	1
1,1-Dichloroethane (CAS 75-34-3)	59	0.0028	100
Chloroform (CAS 67-66-3)	330	0.011	2

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Compound	Maximum Concentration In Groundwater $\mu\text{g}/\ell$	Estimated Airborne Concentration (ppm)	8-hr TWA PEL (ppm)
1,1-Dichloroethene (synonym: Vinylidene Chloride) (CAS 75-35-4)	32	0.004	1
Tetrachloroethene (synonym: Perchloroethylene) (CAS 127-18-4)	33,000	0.072	25
1,1,1-Trichloroethane (synonym: Methyl Chloroform) (CAS 71-55-6)	63	0.0012	350
1,1,2,2-Tetrachloroethane (CAS 79-34-5)	45,000	0.04	1
Trichloroethene (synonym: Trichloroethylene) (CAS 79-01-6)	49,000	0.56	50

4 Nonradioactive Organic Substances that have been found in soils within OU2

The following is a summary of organic substances found in soils. No attempt has been made to estimate airborne concentrations that might be generated by these substances. An organic vapor meter (OVM) will be used during all intrusive activities to detect airborne concentrations of these substances; action levels have been established.

4.1 903 Pad (IHSS No. 112) and 903 Pad Lip Site (IHSS No. 155) Excluding IHSS Sites Within the 902 Pad Lip site

Soils from beneath the 903 Pad and Lip Site have not been analyzed for nonradioactive contamination.

4.2 Trench T-2 (IHSS No. 109), Reactive Metal Destruction Site (IHSS No. 110), and the Gas Detoxification Site (IHSS No. 183)

Compound	Concentration in Soil ($\mu\text{g}/\text{kg}$)
Trichloroethene (synonym: Trichloroethylene) (CAS 79-01-6)	17,000
Tetrachloroethene (synonym: Perchloroethylene) (CAS 127-18-4)	10,000
1,1,1-Trichloroethane (synonym: Methyl Chloroform) (CAS 71-55-6)	250

bis (2 ethylhexyl) phthalate (synonym: Di (2 ethylhexyl) phthalate) (CAS 117-81-7)	3,400
Ethyl Benzene (CAS 100-41-4)	780
Total Xylenes (CAS 1330-20-7)	3,300
Carbon Disulfide (CAS 75-15-0)	58

4.3 Mound Site (IHSS No. 113), Oil Burn Pit (IHSS No 153), and Trench T-1 (IHSS No 108)

Organic contaminants have not been found

4.4 Pallet Burn Site (IHSS No. 154)

Compound	Concentration in Soil (µg/kg)
bis (2 ethylhexyl) phthalate (synonym: Di (2ethylhexyl) phthalate) (CAS 117-81-7)	580
Acetone (CAS 67-64-1)	170
Tetrachloroethene (synonym: Perchloroethylene) (CAS 127-18-4)	20

4.5 Trenches North of Central Ave.; Trench T-3 (IHSS No 110), Trench T-4 (IHSS No 111.1), Trench T-10 (IHSS No. 111.7), and Trench 11 (No 111 8)

Compound	Concentration in Soil (µg/kg)
1,1,1-Trichloroethane (synonym: Methyl Chloroform) (CAS 71-55-6)	190
Nitrosodiphenylamine (synonym: Diphenylnitrosamine) (CAS 86-30-6)	100

- 4 6 Trenches and East Spray Fields South of Central Avenue, Trench T-5 (IHSS No 111 2),
Trench T-6 (IHSS No 111.3), Trench T-7 (IHSS No 111 4), Trench T-8 (IHSS No
111.5), and Trench T-9 (IHSS No 111 6)

Compound	Concentration in Soil ($\mu\text{g}/\text{kg}$)
1,2-Dichloroethane (synonym Ethylene Dichloride) (CAS 107-06-2)	100
Trichloroethene (synonym Trichloroethylene) (CAS 79- 01-6)	150
Tetrachloroethene (synonym Perchloroethylene) (CAS 127-18-4)	62

ATTACHMENT G
MEDICAL SURVEILLANCE REQUIREMENTS

3.0 MEDICAL SURVEILLANCE

Medical surveillance is a major component of the WC health and safety program. It was established to monitor and promote the health of employees engaged in projects which have the potential for exposure to hazardous substances.

Medical surveillance provides a clinical base of information useful in evaluating employee's fitness to work at hazardous waste sites, to identify anomalies in a person's medical history that may be related to potential impaired health, to evaluate a person's capability to use respiratory protection equipment, and to identify illnesses that may be related to chemical exposure while on the job. This base of medical information includes personnel health history, exposure history, physical examination results, laboratory analyses, and results of screening and special tests. Medical examinations include:

- o Past Medical History - on entry to the program, information concerning past occupational exposures and personal as well as family history of disease.
- o Present Medical Profile - all pertinent medical information regarding present state of health and during each year of field work in hazardous material projects.
- o Exposure History - information concerning the cumulative duration of time spent on potentially hazardous sites, the primary toxic substances, and the levels of protection employed by each site.
- o Laboratory Analyses - hematology, liver and kidney function tests, and urinalysis.

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- o Hearing test.
- o Vision test.
- o Pulmonary function test.
- o Electrocardiogram.
- o X-ray.
- o Physical examination.
- o Special Tests - medical information concerning the effects of exposure to specific contaminants.

3.1 OBJECTIVES

The objectives of the medical surveillance component of the health and safety program are:

- o Protect the health of employees assigned to work on hazardous material projects.
- o Pre-assignment screening of employee's health to determine present status and to identify existing problems that may be aggravated by chemical exposures or physical stress.
- o Monitoring employee health for early signs of work-related illness and employee suitability for further field or laboratory assignments on sites containing potentially hazardous substances.

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- o Evaluation and care of individuals with work-related illnesses or injuries.
- o Satisfy the requirements of OSHA Part 1910.134 regarding respiratory protection and OSHA 1910.120 for hazardous waste workers.

3.2 RESPONSIBILITIES OF WC OPERATING UNITS

Each operating unit, through its HSO, must comply with the medical surveillance provisions of the health and safety program. It is the responsibility of the operating unit manager to assure that the following activities are punctually and thoroughly conducted.

- o Arrange for health monitoring services by a qualified local physician or medical organization, preferably with occupational health expertise. The physician must be willing to perform all physician-related tasks described in the WC medical surveillance program.
- o Identify personnel within the operating unit required to enter the program.
- o Inform participants of the specific arrangements for scheduling and receiving medical examinations.
- o Comply with the examining and/or the reviewing physician's recommendations regarding work restrictions and attending to all work-related illnesses.
- o Document and report work/exposure histories for all employees engaged in field activities.

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3.3 REQUIREMENTS

Under Part 1910.120, OSHA requires medical surveillance for personnel involved in hazardous waste operations. OSHA states that persons should not be assigned to tasks unless it has been determined that they are physically able to perform the work and use the equipment.

The OSHA program has two essential components: routine health care and emergency treatment. Routine health care and maintenance shall consist of at least:

1. Pre-employment medical examinations to establish the individual's state of health, baseline physiological data, and ability to wear personal protective equipment. The frequency and type of examination to be conducted thereafter should be determined by medical personnel knowledgeable in the area of occupational medicine.
2. Arrangements to provide special medical examinations, care, and counseling in case of known or suspected exposures to toxic substances. Any special tests performed depend on the chemical substance in which the individual has been exposed.

The site safety plan must address emergency medical care and treatment of personnel, including possible exposures to toxic substances and injuries due to physical hazards. The following items should be considered in emergency care provisions.

- o The name, address, and telephone number of the nearest medical treatment facility should be conspicuously posted. A map and/or directions for locating the

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facility, plus the travel time, should be readily available.

- o The facility's ability to provide care and treatment of personnel exposed or suspected of being exposed to toxic (or otherwise hazardous) substances should be ascertained. If the facility lacks toxicological capability, arrangements should be made for consultant services.
- o All administration arrangements for accepting patients should be made in advance with the facility.
- o Arrangements should be made to quickly obtain ambulance, emergency, fire, and police services. Telephone numbers and procedures for obtaining these services should be conspicuously posted.
- o Emergency showers, eye wash fountains, and first aid equipment should be readily available on-site. Personnel should have first aid and medical emergency training.
- o Provisions should be made for rapid identification of the substance to which the worker has been exposed (if this has not previously been done). This information must be provided to medical personnel.

3.4 MEDICAL EXAMINATIONS

3.4.1 INITIAL BASELINE EXAMINATION

All applicable employees shall be given a baseline examination before being assigned to work at sites containing

potentially hazardous substances. The purpose of the baseline examination is pre-assignment screening.

3.4.2 ROUTINE EXAMINATIONS

All personnel who have taken the initial baseline examination and have received clearance by the examining and/or reviewing physician to participate in field or laboratory activities shall be re-examined on an annual or biennial basis. Generally, employees with less than 100 hours of annual hazardous waste field work will have biennial examinations. Employees with greater than 100 hours hazardous waste field work will have annual examinations. The reviewing physician will have final authority in regard to examination frequency.

3.4.3 EXIT EXAMINATION

An exit examination shall be given to any employee whose employment with WC has included hazardous materials work and who has been a participant in medical surveillance. The exit examination may be waived if the most recent examination was in the past six months.

3.4.4 SPECIAL TESTING

Special testing may be required on certain projects due to the potential for exposure to specific substances. This may also be necessary where the potential for heat or cold stress exists. The need for special testing will be assessed on a project-by-project basis. Examples of special testing conditions include sites containing asbestos, arsenic, or lead where specific OSHA medical requirements for these compounds are in effect.

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3.5 EXAMINATION PROTOCOLS

The protocols presented in Table 3-1 apply to baseline, annual, and exit examinations. A detailed health/work history questionnaire is provided before baseline and routine examinations. The protocols may be expanded by the reviewing or examining physician after consultation with WC.

3.6 PHYSICIAN'S REPORTS

Examining physicians will use information provided by the employee in the questionnaire, the examination results, and the results of laboratory tests to determine if any work restrictions or occupational health problems appear to be present. The examining physician will provide the results of the examination to the WC reviewing physician for final evaluation of employee suitability for work at hazardous material sites. The reviewing physician's conclusions shall supercede those of the examining physician. A physician's report on the examination will be sent directly to the employee with a separate letter stating ability to work at hazardous waste sites sent to WC.

Employer reports received by WC shall be reviewed by the HSO and kept in the Operating Unit's health and safety file. Physician recommendations regarding limitations must be followed.

3.7 EMPLOYEE MEDICAL SURVEILLANCE PROGRAM

The employee medical surveillance program (EMSP) is a computerized database which stores and processes employee medical surveillance information such as medical examination results, exposure history, training and respirator fit testing data. The purpose of EMSP is to facilitate record documentation, the reviewing physician's evaluation of the medical surveillance data,

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and administration of the WC Health and Safety Program. Administrative and quality control features include: profile reports on employee eligibility for site work, medical examination scheduling reports, training requirement notices, and listing of qualified staff by operating unit and firmwide.

3.8 REVIEWING PHYSICIAN

Dr. Peter Greaney of Anaheim, California has been retained to provide medical oversight to the WC medical surveillance program. The reviewing physician receives copies of all medical questionnaires, examinations, and laboratory testing results, reviews the opinions of examining physicians, and determines an employee's fitness for work at hazardous material sites. The physician also provides advice and assistance regarding site specific medical monitoring needs and programs.

3.9 CONFIDENTIALITY

Employee medical records are confidential and available for review only by the examining and/or reviewing physicians and their medical personnel.

Each employee can obtain information on his/her health by asking the examining physician for the information at the time of, or after, an examination. The employee may also request release of records or information, and/or designate a representative, in a letter to the physician. The request must contain the full name and address of the representative and indicate the records to be released. Medical information about an employee will not be made available to anyone without authorization from the individual concerned.

3.10 FINANCIAL RESPONSIBILITY

The costs of baseline, routine, special, and exit examinations will be paid to the examining physician by WC operating units. The cost of examinations and tests that the employee voluntarily takes on recommendations by the examining or reviewing physician shall be borne by the employee unless the examinations/tests are related to the employee ability to work or to diagnose a work-related illness. The cost of the reviewing physician and the EMSP data base will be paid by Corporate Health and Safety.

TABLE 3-1
MEDICAL EXAMINATION PROTOCOL

<u>Test</u>	<u>Testing Frequency</u>			<u>Remarks</u>
	<u>Baseline</u>	<u>Routine</u>	<u>Other</u>	
1. Cardiogram	X		X	Preplacement Every 3 years for less than or equal to 40 years old. Every examina- tion for more than 40 years old.
2. Chest X-Ray	X		X	Preplacement Every 3 years for less than or equal to 40 years old. Every 2 years for more than or equal to 40 years old to less than or equal to 55 years old. Every exam for more than 55 years old.
3. Audiogram	X	X		
4. Blood Chemistry Panel	X	X		

Required:

Glucose
 Sodium
 Potassium
 Chloride
 BUN
 Creatinine
 Uric Acid
 Phosphate
 Calcium
 Cholesterol
 Triglycerides
 Total Protein
 Albumin

TABLE 3-1
(continued)

<u>Test</u>	<u>Testing Frequency</u>			<u>Remarks</u>
	<u>Baseline</u>	<u>Routine</u>	<u>Other</u>	
4. Blood Chemistry Panel Required: (continued)				
Globulin				
Total Bilirubin				
Direct Bilirubin				
Alk. Phosphatase				
G-Glutamyl Transpep.				
Transaminase, SGO				
Transaminase, SGP				
LDH				
Iron				
Optional:				
Magnesium				
Albumin/Globulin Ratio				
BUN/Creatinine Ratio				
CBC Count (Hemogram)	X	X		
WDC				
RBC				
HGB				
HCT				
MCV				
MCH				
MCHC				
Differential White Count		X		
Seg				
Band				
Lymph				
Mono				
Eosin				
Baso				
Platelets				
Platelets Count				
Reticulocyte Count				
6. Serum Iron and Total Iron Binding Capacity (TIBC)	X			

TABLE 3-1
(continued)

<u>Test</u>	<u>Testing Frequency</u>			<u>Remarks</u>
	<u>Baseline</u>	<u>Routine</u>	<u>Other</u>	
7. Urinalysis	X	X		
Appearance				
Color				
pH				
Ketones				
Direct Bilirubin				
Total Bilirubin				
Glucose				
Blood				
Urobilinogen				
L. Esterase				
WDC				
RBC				
Casts				
Mucus				
Bacteria				
Eiptherlial				
Crystals				
Yeast				
MCG/DL				
8. Morphology (Present, Absent, Unknown)	X	X		
Anisocytosid				
Poikilocytosis				
Hypochromia				
Polychromasia				
Basophilic Stippling				

TABLE 3-1
(continued)

<u>Test</u>	<u>Testing Frequency</u>			<u>Remarks</u>
	<u>Baseline</u>	<u>Routine</u>	<u>Other</u>	
9. Treadmill			X	*Only if: o Abnormal EKG (except sinus bradycardia, unless an otherwise healthy person); or o History of angina; or o History of myocardio infarction (MI); or o History of cardiac surgery.
10. Vision Test (R&L) Near-Corrected and Uncorrected Far-Corrected and Uncorrected Peripheral (Visual Field) Color Depth Perception	X	X		
11. Height and Weight	X	X		
12. Blood Pressure	X	X		
13. Pulse (resting)	X	X		
14. Temperature (oral) Fahrenheit	X	X		
15. Pulmonary Function Test	X	X		

/HS2

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ATTACHMENT H
WC ACCIDENT/INCIDENT FORM

OPERATING PROCEDURE NO. HS-502

502.1 INCIDENT REPORTS

All health and safety incidents that occur during field and laboratory activities associated with investigations and remediation of sites containing hazardous materials must be reported to management.

502.2 DEFINITIONS

A health and safety incident is any event listed below:

- o Illness resulting from chemical exposure or unknown causes.
- o Physical injury, including those that do not require medical attention.
- o Fire, explosions, and flashes resulting from activities performed by WCC and its subcontractors.
- o Property damage resulting from activities performed by WCC and its subcontractors.
- o Vehicular accidents occurring on-site or while travelling to and from sites.
- o Infractions of safety rules and requirements.
- o Unexpected chemical exposures (indicated by irritation of eyes, nose, throat, or skin).

502.3 REPORTING PROCEDURES

502.3.1 REPORTING FORMAT

Incident reports shall be prepared by completing Form HS-502. This form may be obtained from any WCC health and safety officer.

502.3.2 RESPONSIBLE PARTY

Reports of incidents occurring in the field shall be prepared by the site safety officer or, in the absence of the site safety officer, the supervising field engineer, witness, or injured/exposed individual.

502.3.3 FILING

A report must be submitted to the health and safety officer of the business unit to which the project manager belongs within 24 hours of each incident involving medical treatment. In turn, the health and safety officer must distribute copies of the report to the corporate health and safety administrator and the corporate health and safety officer. When an injury or illness is reported, the business unit health and safety officer must deliver a copy of the report to the individual in charge of personnel affairs so that a Worker's Compensation Insurance Report can be filed if necessary. Reports must be received by personnel within 48 hours of each qualifying incident.

/H&S2

Health & Safety Plan (Accident Prevention Safety Program Plan) Rocky Flats
Plant Phase II RFR/RI 903 Pad Mound, and East Trenches Area (Operable Unit
2) Rocky Flats Plant April 1991
Document Control Number RFR/MRS 97-079 Revision 0 0
EG&G Rocky Flats Inc

ATTACHMENT I
EMERGENCY ALERT SIGNALS

EMERGENCY ALARMS

WARNING	SOUND	INSTRUCTIONS
FIRE ALARM	BELL	EVACUATE AREA
CIVIL DEFENSE WARNING ALARM	HIGH FREQUENCY PITCH STEADY TONE	FOLLOW PUBLIC ADDRESS INSTRUCTION & BLDG ANNOUNCEMENTS
CIVIL DEFENSE ATTACK ALARM	WAILING SIREN	FOLLOW PUBLIC ADDRESS INSTRUCTIONS
CRITICALITY ALARM	WAILING TONE	EVACUATE BLDG & ASSEMBLE IN EVACUATION AREA
GLOVEBOX OVERHEAT ALARM	WAVERING TONE	FOLLOW BLDG INSTRUCTION VENTILATION SHUTS OFF
SAM ALARM	WAVERING TONE	FOLLOW BLDG INSTRUCTIONS VENTILATION SHUTS OFF
GENERAL FIRE ALARM IN PLUTONIUM/URANIUM PROCESSING PLANT	WAVERING TONE	EVACUATE AREA

ATTACHMENT J

INTERIM PLAN FOR PREVENTION OF CONTAMINANT DISPERSION

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INTERIM PLAN FOR PREVENTION OF CONTAMINANT DISPERSION

OBJECTIVE

The objective of this Interim Plan for Prevention of Contaminant Dispersion (IPPCD) is to establish procedural requirements to mitigate potential hazards, on an interim basis, to persons located offsite as a result of contact with emissions resulting from intrusive remedial investigation activities.

SCOPE

Procedural requirements identified herein are applicable to certain intrusive actions taken at the 16 Operable Units (OUs) as part of the RFI/RI activities described in the Interagency Agreement (IAG). Intrusive activities which fall within the scope of this IPPCD are those with the potential for producing appreciable quantities of suspended particulate, primarily through mechanical actions. Intrusive activities potentially susceptible to producing appreciable quantities of suspended particulate include:

- Monitoring well and soil/rock borehole installation
- Excavations such as trenching and test-pitting using powered equipment

Additionally, heavy vehicular traffic associated with intrusive RFI/RI activities shall be considered susceptible to producing appreciable quantities of suspended particulate. By contrast, activities such as surface soil sampling with hand implements are not considered susceptible to producing appreciable quantities of suspended particulate.

Procedural requirements identified herein must be evaluated on a case-by-case basis to determine their potential impact on other IAG objectives. For example, it is possible that applying certain dispersion techniques, such as wetting, could compromise sample integrity and limit the usefulness of the data for which the sampling was intended.

The procedural requirements identified in the IPPCD shall remain in effect until the final PPCD is approved or until modifications are substantiated, approved, and documented in the Site Specific Health and Safety Plan (SSH&SP).

RESPONSIBILITY

The EG&G RFI/RI Project Manager (PM) shall be responsible for assuring that activities conducted at his/her OU are performed in accordance with the requirements identified herein.

The Remedial Projects Division (RPD) Manager will be responsible for follow-up and auditing the PM.

PROCEDURAL REQUIREMENTS

A pre-startup activity review shall be conducted by the PM and the Activity Field Supervisor to evaluate the potential for particulate emissions to create hazardous conditions. If the activity is being performed by non-EG&G personnel, the subcontractor's Activity Field Supervisor shall participate in the review.

The pre-startup activity review involving intrusive activities where there is a significant potential for producing appreciable quantities of suspended particulate shall be documented by completion of a Radiological/H&S Work Permit (HSP 6.05) and an Excavation Permit (HSP 6.01). HSP's 6.05 and 6.01 are attached.

If the review establishes that there is a significant potential for producing appreciable quantities of suspended particulates that could create hazardous conditions, the specific procedural requirements identified below shall govern the activity.

SPECIFIC REQUIREMENTS

Activities where there is a significant potential for producing appreciable quantities of suspended particulates shall not be conducted when the following conditions exist:

- Sustained wind speeds above 15 miles per hour (mph) as measured by a site-located anemometer. Sustained winds above 15 mph exist when the 15-minute average wind-speed exceeds 15 mph for two consecutive 15-minute periods.
- Soil moisture content less than 15% in areas where major excavation or scraping is planned as measured with a Soiltest "Speedy Moisture Tester" or an equivalent instrument.

- In the special case of excavations, the top 6" of soil will be moved (i.e., scraped) and placed in a low pile and covered with a tarp or other suitable covering to prevent resuspension of particulates. The width of the scraped zone shall be wide enough to accommodate the expected volume of soil from the excavation, without coming into contact with unexcavated adjacent surface soil.

Air quality monitoring requirements for activities where there is a significant potential for producing appreciable quantities of suspended particulate include the following:

- Site perimeter and community Radiological Ambient Air Monitoring Program (RAAMP) monitoring.
- Local monitoring of Respirable Suspended Particulate (RSP) at individual activity worksites shall be conducted using a TSI "Piezobalance" Model 3500 Respirable Aerosol Mass Monitor, real-time instrument. Local RSP measurements will be used to guide the PM's evaluation of the potential hazards associated with activity related emissions. The threshold RSP concentration for curtailing intrusive activities will be 6.0 milligrams/cubic meter (mg/m³).
- Additional worker health and safety monitoring as required by the SSH&SP.

Additional requirements that govern activities where there is a significant potential for producing appreciable quantities of suspended particulates that could create hazardous conditions include the following:

- Excavate soils that are not promptly backfilled shall be covered with a tarp or similar cover to prevent resuspension of particulates.
- Vehicular traffic will be minimized to the extent practicable.
- Vehicular traffic shall not exceed 5 mph.
- Roadways will be watered as necessary.
- Access paths leading to activity sites that are not on roadway will be watered to prevent the generation of particulates from vehicular traffic during access and egress.

Activity specific requirements will be evaluated periodically to determine their effectiveness at preventing dispersion of contaminants. Modifications to these requirements will be documented in the SSH&SP.

ATTACHMENT K
NIOSH METHOD 1007

VINYL CHLORIDE

FORMULA: $\text{CH}_2=\text{CHCl}$; $\text{C}_2\text{H}_3\text{Cl}$

M.W.: 62.50

METHOD: 1007

ISSUED: 2/15/84

OSHA: 1 ppm; C 5 ppm
NIOSH: minimum measurable
ACGIH: 5 ppm (human carcinogen) [1]
(1 ppm = 2.56 mg/m³ @ NTP)

PROPERTIES: BP -14 °C; vapor density 2.2 (air = 1)

SYNONYMS: chloroethylene; chloroethene; CAS #75-01-4.

SAMPLING	MEASUREMENT
SAMPLER: SOLID SORBENT TUBE (2 tandem tubes, each with 150 mg activated coconut charcoal)	! TECHNIQUE: GAS CHROMATOGRAPHY, FID ! ! ANALYTE: vinyl chloride !
FLOW RATE: 0.05 L/min	! DESORPTION: 1 mL carbon disulfide; 30 min !
VOL-MIN: 0.7 L -MAX: 5 L	! INJECTION ALIQUOT: 5 µL !
SHIPMENT: separate primary and backup tubes and cap each	! COLUMN: stainless steel, 6.1 m x 3.2 mm, 10% SE-30 on 80/100 mesh Chromosorb W (AW-DMCS) !
SAMPLE STABILITY: 10 days @ 25 °C	! CARRIER GAS: He, 40 mL/min !
BLANKS: 2 to 10 field blanks per set	! TEMPERATURE-INJECTOR: 230 °C ! -DETECTOR: 230 °C ! -COLUMN: 60 °C !
ACCURACY	! CALIBRATION: solutions of vinyl chloride in CS ₂ !
RANGE STUDIED: 1 to 64 mg/m ³ [2]	! RANGE: 0.002 to 0.2 mg per sample [2] !
BIAS: -6% of calculated concentration [2]	! ESTIMATED LOD: 0.00004 mg per sample [2] !
OVERALL PRECISION (s _r): 0.06 [2]	! PRECISION (s _r): not determined !

APPLICABILITY: The working range is 0.4 to 40 mg/m³ (0.16 to 16 ppm) for a 5-L air sample.
The method is applicable to 15-min samples at concentrations of 1 ppm or higher.

INTERFERENCES: Other than the possibility of loss of sample upon storage of two weeks or more
at room temperature, none have been noted.

OTHER METHODS: This is a revision of PCAM 178 [3].

METHOD 1007

VINYL CHLORIDE

7. Transfer the charcoal from the front and back tubes to separate vials. Discard the glass wool and foam plugs. Seal the vials with septum caps immediately.
8. Allow to stand for 30 min, with occasional agitation. Analyze the sample within the next 30-min period.

CALIBRATION AND QUALITY CONTROL:

9. Calibrate with at least five working standards covering the range 0.0002 to 0.2 mg per sample.
 - a. Add known amounts of calibration stock solution to CS₂ in 10-ml volumetric flasks and dilute to the marks, using serial dilution as appropriate.
 NOTE: Working standards can be stored at -20 °C for at least three days.
 - b. Analyze together with samples and blanks (steps 12 and 13).
 - c. Prepare calibration graphs of peak area vs. quantity (mg) of vinyl chloride per tube and peak area vs. quantity (ng) per injection.
10. Determine desorption efficiency (DE) at least once for each lot of charcoal used in the calibration range (step 9). Prepare three tubes at each of five levels plus three media blanks.
 - a. Prepare three atmospheres of vinyl chloride in air by injecting 0.01, 0.08, and 0.2 mL vinyl chloride gas into 10 L air in Tedlar bags. The resulting concentrations are approximately 2.6, 21 and 52 mg/m³.
 - b. Following steps 1 through 4, sample these atmospheres according to the following scheme:

Concentration in Bag (mg/m ³)	Volume Sampled (L)	Quantity of Vinyl Chloride (mg)
2.6	0.8	0.002
	2.2	0.006
21	0.8	0.017
	2.2	0.046
52	2.5	0.13

Obtain three samples at each level.

- c. Desorb (steps 6 through 8) and analyze together with working standards (steps 12 and 13). No vinyl chloride should be found on the back tubes.
- d. Analyze the atmospheres in the bags (steps 12 and 13) using 1-ml gas samples. Read from the calibration graph the quantity (ng) per injection, which for a 1-ml injection of gas is numerically equal to the concentration in mg/m³.
- e. Calculate DE from the mass (mg) of vinyl chloride on the front tube (M_f), the average blank (B), the concentration of vinyl chloride in the synthetic atmospheres (C_s, mg/m³), and the volume of air sampled (V, L):

$$DE = \frac{(M_f - B) \cdot 10^3}{(C_s)(V)}$$
- f. Prepare a graph of DE vs. mass found (M_f - B).
11. Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graph are in control.

ATTACHMENT L

ORGANIZATIONAL STRUCTURE OF ROCKY FLATS PLANT HEALTH AND SAFETY ACTIVITIES

CHAPTER 2

ORGANIZATIONAL STRUCTURE

2.1 Plant Organization

Environmental restoration activities at the Rocky Flats Plant (RFP) are directed by the Associate General Manager for Environmental Restoration (ER) and Waste Management (see Figure 2-1). ER Program Activities (CERCLA and RCRA response actions) involve the following ER Divisions:

- o Remediation Programs Division (RPD)
- o Environmental Monitoring and Assessment Division (EMAD)
- o National Environmental Policy Act Division (NEPA)
- o Clean Water Action Division (CWAD)
- o Clean Air and Environmental Reporting (CAER)

(See Figure 2-2 for the organizational structure of the Environmental Restoration Department.)

Health and Safety (H&S) activities at the RFP are under the direction of the Associate General Manager for Support Operations (see Figure 2-3). ER Program Activities receive support from the following H&S divisions:

- o Radiological Operations
- o Occupational Safety
- o Health and Safety Area Engineering
- o Industrial Hygiene
- o Radiological Engineering
- o Occupational Health

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Facilities Engineering (FE) and Facilities Project Management (FPM) also provide support to the ER program activities. FE's role is to provide engineering designs, oversight, and management of design projects. The Project Engineer (PE) from FE directs all project design activity, ensures the user's technical requirements are met, ensures conformance with plant design standards and obtains design concurrence from RFP technical support groups (e.g., Facilities Quality Engineering, Design Verification Engineering, Fire Protection Engineering, Plant Electrical and Plant Utilities Engineering, Operations, Maintenance and Utilities Management, etc.). FPM administers the implementation of engineering designs through Construction Management (CM). CM, a branch within FPM, is responsible for assisting ER with obtaining approval for work permits for land use and work activities, and for managing/coordinating general construction contractors and their quality of work. A Construction Coordinator, identified by CM, is responsible for coordinating with various departments within the RFP to obtain permits, escorts and access justification in addition to other supporting functions, as needed by Subcontractors.

Appendix IV contains a list of RFP departments or divisions that are mentioned in this Plan along with available phone numbers and contacts.

2.2 Responsibilities of Individuals

2.2.1 Division Managers

Environmental Restoration and Health & Safety division managers are responsible for managing programs and supervising project managers in the implementation of ER and H&S activities.

2.2.2 Environmental Restoration Health and Safety Officer (Dennis Smith)

The Environmental Restoration Health and Safety Officer (ERHSO) is responsible for managing and implementing the ER Health and Safety Program. Environmental Restoration is responsible

for project planning, contracting, and managing ER projects, therefore, the ER HSO will ensure the a Site-specific Health and Safety Plan is written for each Operable Unit; ensure that subcontractors prepare site- or task-specific health and safety plans for approval; and provide support to project managers in the area of environmental health and safety through his/her expertise and that of the environmental support divisions.

2.2.3 Remediation Programs Site Project Manager (Brook Wilson)

The RP Site Project Manager is the direct line supervisor responsible for project work on a designated ER site. He/she reports directly to the RPD Manager. The RP Site Project Manager has overall control and responsibility for the management of the project, including enforcement of health and safety requirements. The Project Manager is the single-point-of-contact for implementing ER's needs and requirements through the Project Administrator.

2.2.4 Health & Safety Liaison Officer (Dina Sassone)

The H&S Liaison Officer is assigned from the Occupational Safety Division to the Environmental Restoration Division to serve as the central point-of-contact for supporting the ER Program for all operational health and safety needs. The H&S Liaison Officer reports to the Occupational Safety Division Manager and interacts directly with the ER Site Project Managers and the ER Health and Safety Officer. He/she also supervises the EG&G Site Health and Safety Coordinators. The H & S Liaison Officer has the following responsibilities:

- o Coordinates health and safety activities with the ER H&S Officer and the ER Site Project Managers
- o Implements the HSPP by providing and supervising EG&G Site Health and Safety Coordinators at each designated ER site
- o Prepares EG&G Health and Safety Plans (HSPs)

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- o **Coordinates approval of Site-specific (Task-Specific) Health and Safety Plans prepared by Subcontractors and their lower-tier subcontractors with all health and safety disciplines**
- o **Performs periodic health and safety audits and inspections of the subcontractor health and safety programs, and program documentation**

2.2.5 Site Health and Safety Coordinator (Brian Fielding)

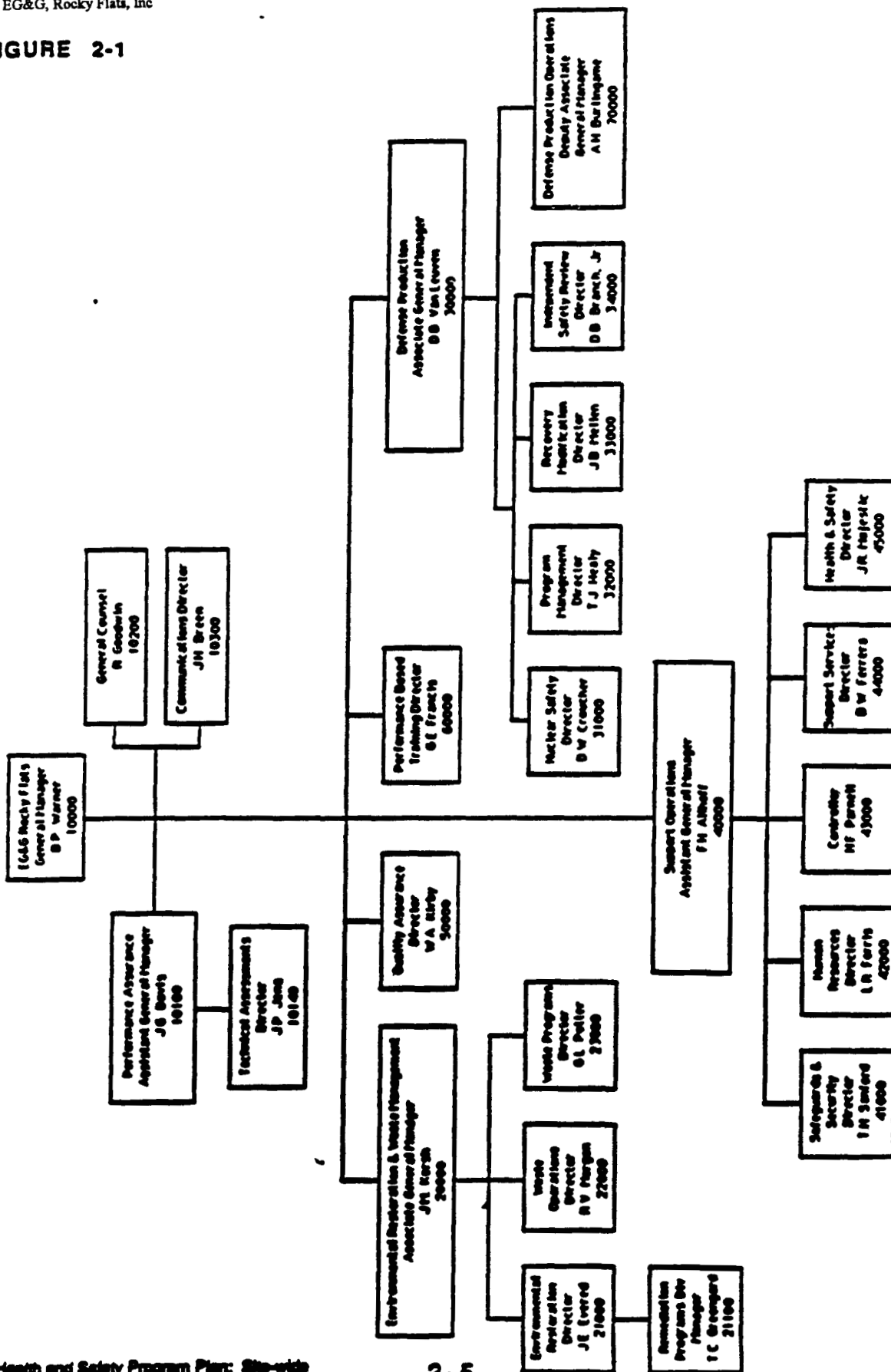
A Site Health and Safety Coordinator (SHSC) will be assigned from the Health and Safety Department by the Health & Safety Liaison Officer to oversee Health and Safety Plan Implementation at each Operable Unit. The SHSC will report to the H&S Liaison Officer and will keep the RP Site Project Manager informed of health and safety related activities on the site. The SHSC has the following responsibilities:

- o **Oversees EG&G and subcontractor work to ensure that the requirements and principles of this HSPP and the Site Specific HSPs are followed,**
- o **Performs audits for proper and appropriate use of PPE, monitoring and decontamination procedures, access control and required documentation,**
- o **Alerts the ER Site Project Manager and the H&S Liaison Officer of health and safety violations at the ER remedial project work site,**
- o **Coordinates with appropriate health and safety divisions to provide for radiation monitoring, medical surveillance, emergency response, industrial hygiene support and H&S engineering support,**
- o **Provides on-site health and safety support at all times for tasks performed by EG&G employees beyond project management and oversight.**

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FIGURE 2-1

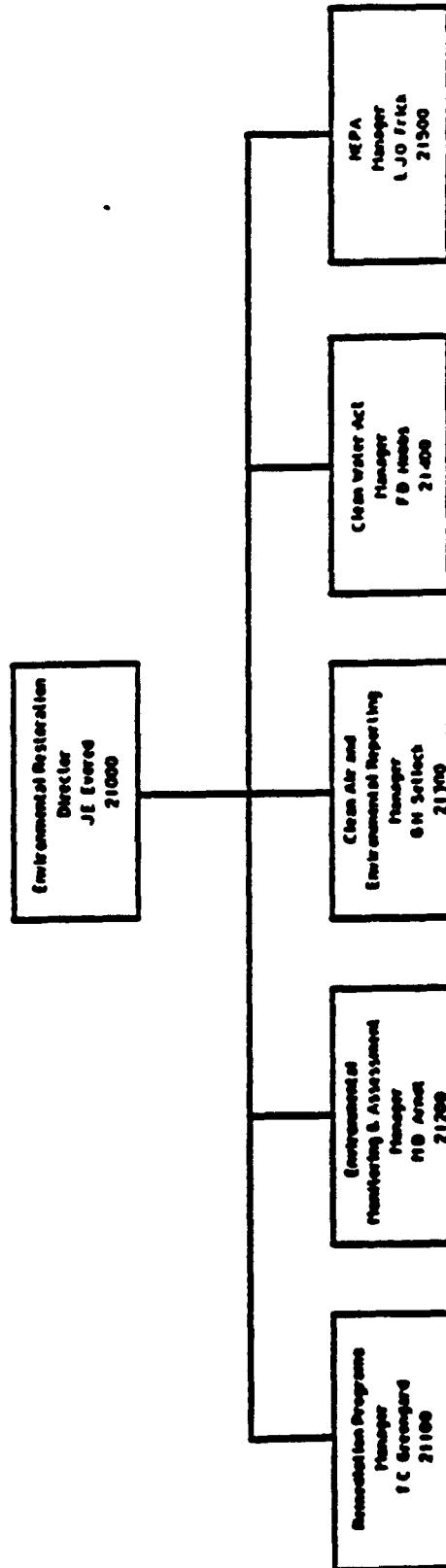
EG&G ROCKY FLATS
 ORGANIZATION



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FIGURE 2-2

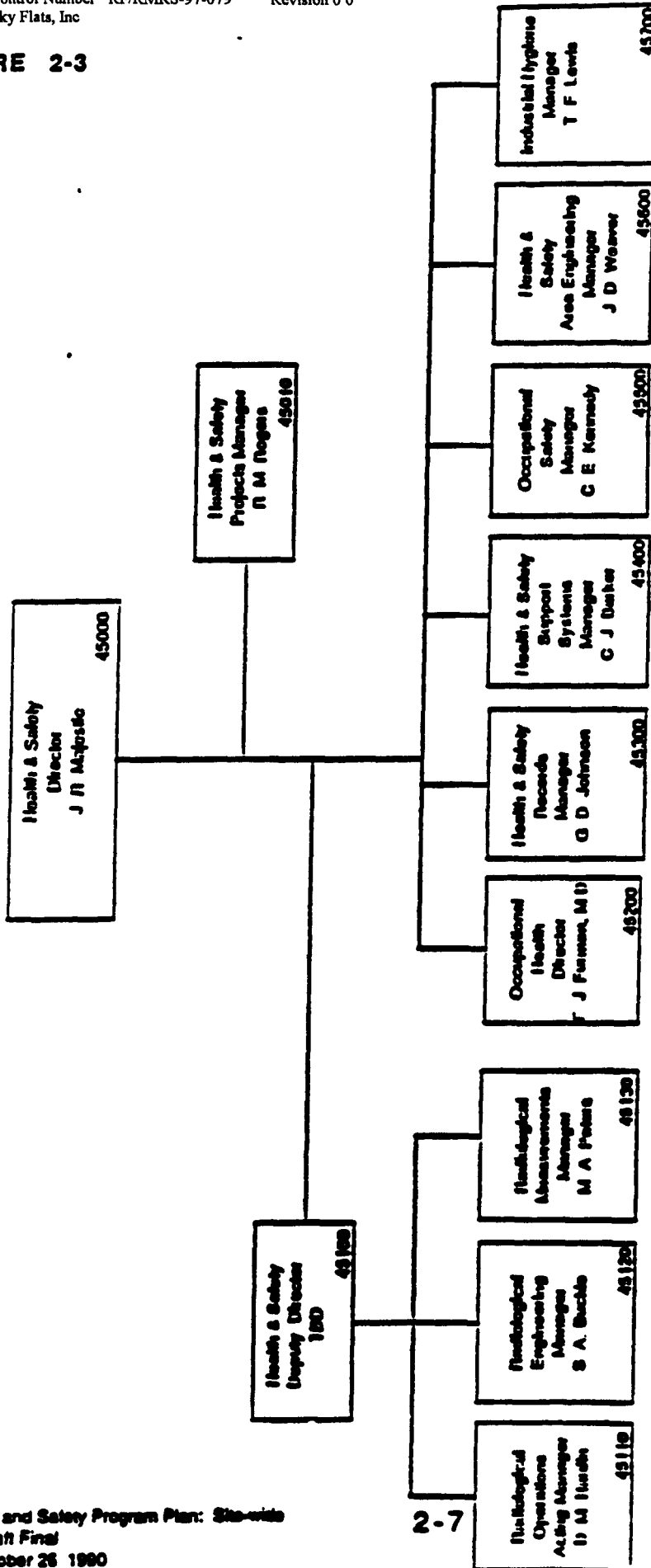
ENVIRONMENTAL RESTORATION



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FIGURE 2-3

HEALTH AND SAFETY



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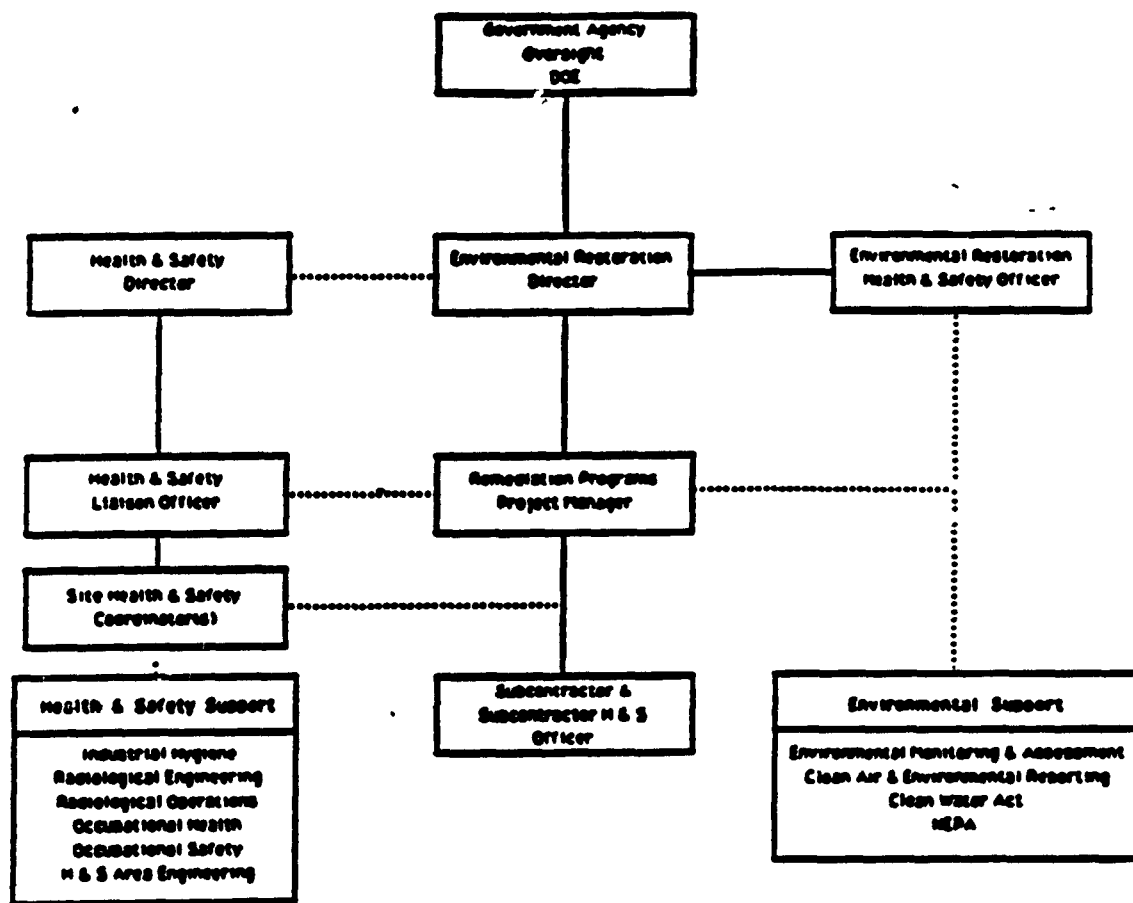
EG&G ROCKY FLATS
 Organization
 DE AC04 900P62349

Health and Safety
 CHART 45000
 APR 9, 1990

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FIGURE 2-4

RP PROJECT ORGANIZATIONAL CHART



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Supplement to Site-Specific Health and Safety Plan Operable Unit No. 2

for

Rocky Flats Plant

In Compliance with
DOE ORDER 5400.1

Document Control Number
RFP/ER-SAF-93-OU2.1

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**Supplement to Site-Specific
Health and Safety Plan
Implementation of
Phase II RFI/RI Work Plan**

**Rocky Flats Plant
Operable Unit No. 2**

Surficial Soil Program at Rocky Flats Plant

Prepared for

THE U S DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE
GOLDEN, COLORADO

PREPARED BY

EG&G ROCKY FLATS, INC
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GOLDEN, COLORADO 80401-0464

November 29, 1993

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REVIEW WAIVER PER
Date CLASSIFICATION OFFICE

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**ROCKY FLATS PLANT
SUPPLEMENT TO SITE-SPECIFIC
HEALTH AND SAFETY PLAN FOR
OPERABLE UNIT NO. 2 (OU 2)**

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95-DMR-ERM-0009	Cancellation of 94-DMR-ERM-0052	0	01/25/95
	Detailed Table of Contents	0	12/14/93
1 0	Introduction	0	12/14/93
2 0	Health and Safety Responsibilities	0	12/14/93
3 0	Hazard Assessment	0	12/14/93
4 0	Hazard Communication	0	12/14/93
5 0	Site Control	0	12/14/93
6 0	Personal Protective Equipment (PPE)	0	12/14/93
7 0	Decontamination	0	12/14/93
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9 0	Radiological Screening Program	0	12/14/93
10 0	Training	0	12/14/93
11 0	Emergency Information	0	12/14/93
12 0	References	0	12/14/93
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Addendum # 2	Planned Intrusive Activities During Spring-Summer, 1994	0	05/03/94

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SUPPLEMENT TO SITE-SPECIFIC
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Addendum # 5	Modification To Planned Intrusive Activity, Fall, 1994	0	10/14/94
Addendum # 6	Planned Site Decommissioning Activities During Late '95 & Early '96 and Reduction In The Buddy System Requirement	0	10/25/95
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Appendix A	Heat and Cold Stress Guidelines	0	09/09/97
Appendix B	Material Safety Data Sheets	0	09/09/97

1/25/19

1/25/19

**Refer to 1-A01-PPG-001 for Processing Instructions.
Print or Type All Information (Except Signatures)**

1 Date 1-24-95	23. DMR No. 95-DME-ERM-0009
3 New Document Number or Document Number if it is to be changed with this Revision	
5 Document Title SUPPLEMENT TO SITE-SPECIFIC HEALTH & SAFETY PLAN O.U. 2	
<input type="checkbox"/> Noncontent Change <input type="checkbox"/> Editorial Correction <input checked="" type="checkbox"/> Cancellation	

1. Existing Document Number/Revision RFP/ER-SAF-93-002.1			3. New Document Number or Document Number if it is to be changed with this Revision 1-27-94		
2. Originator's Name/Phone/Page/Location S. HOWARD 18748/17475/BLDG 080			5. Document Title SUPPLEMENT TO SITE-SPECIFIC HEALTH & SAFETY PLAN O.U. 2		
6. Document Type <input type="checkbox"/> Procedure <input checked="" type="checkbox"/> Other _____			7. Document Modification Type (Check only one) <input type="checkbox"/> New <input type="checkbox"/> Revision <input checked="" type="checkbox"/> Intentional Change <input type="checkbox"/> Nonintentional Change <input type="checkbox"/> Editorial Correction <input checked="" type="checkbox"/> Cancellation		
8. Item	9. Page	10. Step	11. Proposed Modifications		
			<p>CANCEL LIMITED SCOPE VERSION ISSUED 5-24-94</p> <p>WORK COMPLETED</p> <p>94-PMR-ERM-0052</p>		

12. Justification (Reason for Modification, EIO, TP, etc.)

WORK HAS BEEN COMPLETED

[illegible]

6. Originator's Signature (print/typed name) EC MAST <i>EMash</i> 1/24/95				
17. Applicant SME/Photo/Phone Location S Hollowell 18748/7475	18. Case Center	19. Charge Number	20. Requested Completion Date	21. Review Date 1/25/95
22. Accountant Review? Yes <input type="checkbox"/> No <input type="checkbox"/>	23. ORC Review			
24. Approving Manager (print, typed name) EC MAST <i>EMash</i> 1/24/95				

REVIEWED FOR CLASSIFICATION - 1000

BY VA
DATE VA

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Approved by

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Project Manager

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QA Program Manager

1.0 INTRODUCTION

1.1 POLICY

This Supplemental Health and Safety Plan (HSP) was developed for the implementation of activities associated with the existing Surficial Soil Program (SSP) project which is located east of the 903 Pad and is associated with Operable Unit 2 (OU2). This plan supplements the most recent version of the OU2 Site-Specific HSP (SSHSP). It has been developed for compliance with Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Regulations 29 Code of Federal Regulations (CFR) 1910.120 for hazardous waste site workers at the Rocky Flats Plant (RFP). The intent of the supplement is to define the hazards which may be present and identify the procedures which will be followed to protect all project personnel from those hazards. This supplement shall also apply to all subcontractors who are participating in the field activities of this project. This plan addresses the requirements for personnel managing, monitoring, and performing activities associated with the SSP project. All subcontractor personnel will follow this HSP in addition to the requirement of the SSHSP and all RFP procedures and policies when conducting work at the project site. A signature sheet will be kept to document that all site workers have read, understand, and will comply with all aspects of this plan. The subcontractor has the responsibility for implementing the requirements of this SSHSP. The subcontractor will provide health and safety briefings, field activity oversight, and maintain appropriate health and safety records.

1.2 REGULATIONS AND GUIDELINES

Adherence to applicable federal, local, and national consensus organization health and safety standards, regulations, and guidance manuals is required during field activities of the SSP. These include, but may not be limited to, the following:

- 29 CFR 1910, Occupational Safety and Health Standards, General Industry (latest edition),
- 29 CFR 1926, Occupational Safety and Health Standards, Construction Industry (latest edition),
- Nuclear Regulatory Commission 10 CFR 20 (latest edition),
- Department of Energy (DOE) Order 5480 11 (with revisions),
- Radiological Operating Instructions (ROI), EG&G Rocky Flats, Inc (with revisions),
- Environmental Management Radiological Guidelines (EMRG) Manual, EG&G Rocky Flats, Inc (with revisions),
- Health and Safety Practices Manual (HSPM), EG&G Rocky Flats, Inc (with revisions),
- Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (latest edition),
- Occupational Safety and Health Guidance for Hazardous Waste Site Activities, U S Department of Health and Human Services et al , October 1985
- Radiological Control Manual, DOE, June, 1992

1.3 CONTENTS OF PLAN

This plan describes known hazardous materials and work operations associated with the activities of the SSP. The plan specifies responsibilities and authorities of the subcontractor and subcontractor personnel involved in the supervision of activities at this site. This plan further describes the requirements for medical surveillance, personal protective equipment (PPE), hazard communication, training, monitoring, decontamination, site control, and emergency response procedures.

The potential hazards associated with the SSP activities have been assessed by reviewing historical activities, previously performed studies, and personal communications with previously associated project personnel. Based on the hazard assessment, plans for PPE, monitoring, decontamination, site control, and emergency response have been developed.

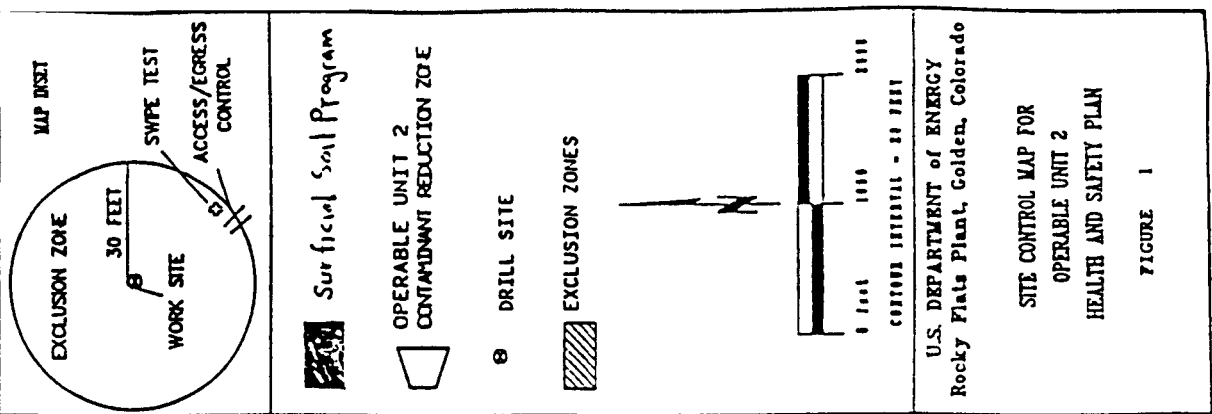
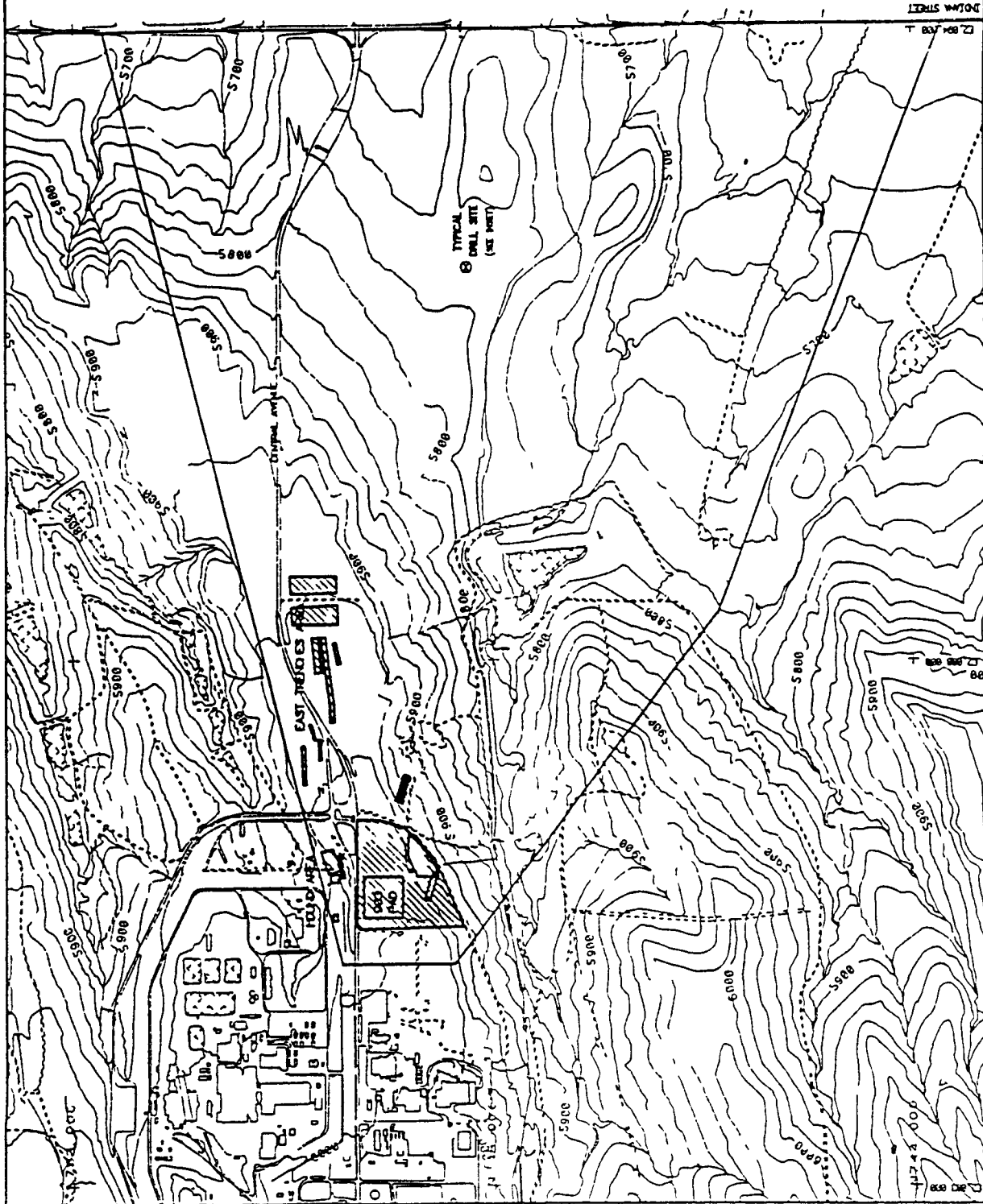
1.4 BACKGROUND

A comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions is in progress at RFP. These investigations are being conducted pursuant to the 1986 Compliance Agreement between DOE, the U.S. Environmental Protection Agency (EPA), and the Colorado Department of Health, which addresses hazardous and radioactive mixed waste management at the plant.

The SSP supports the alluvial work plan for the Phase II Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Remedial Investigation (RI) of OU2 and site wide characterization of soils at RFP. The SSP investigates the physiochemical attributes of actinides in soil east of the former storage site (locally known as the 903 Pad) as well as the temporal changes in actinides in the soil environment around RFP. Refer to Figure 1 4-1 for the location of the project.

The seven tasks that will be performed by this project include,

- Sample Soil Interstitial Waters for Actinides Analyses
- Maintain and Enhance the Soil Water Monitoring System
- Support and Calibrate the Time Domain Reflectometry
- Support Rain Simulation Experiments
- Installation and Support of Snow Water System
- Support Soil Erosion Studies
- Conduct Annual Soil Sampling for Actinides around RFP



1.5 LOCATIONS AND DESCRIPTIONS

The SSP is located in the Americium Zone east of the 903 Pad. The 903 Pad was used as a temporary storage area for radioactive materials. Subsequent remediation efforts allowed airborne release of some of these materials. The areas down wind of this pad have been since referred to as the Americium Zone. The project site has been designated as a Radiologically Controlled Area (RCA). Previous activities in the project area involved intrusive operations during installation of equipment. The activities involved with the present phase of the SSP project are not expected to require significant intrusive operations.

2.0 HEALTH AND SAFETY RESPONSIBILITIES

2.1 INTRODUCTION

Health and safety is the responsibility of all personnel working on the site. The subcontractor (Stoller) will provide the required health and safety services including daily sampling, screening all personnel and equipment for radionuclides, briefings, and oversight. Stoller has expressed a strong commitment to ensuring a safe work environment for all workers on the project. The project organization (Figure 2.1-1) will follow the lines of responsibility as described in EMRG Guideline 1.0. As contracted, a qualified individual may serve in more than one role. Individual contracted project personnel responsibilities are identified in the following sections.

2.2 ASSIGNMENT OF RESPONSIBILITIES

2.2.1 Stoller Program Manager

The Stoller Program Manager for the SSP project has overall responsibility for work performed by Stoller and subcontractors at the site. The Program Manager, through line management and supervisors, has responsibility for implementing and abiding by the SSHSP. The Project Manager has appointed an employee to serve as the Site Safety Officer (SSO). Stoller personnel and all subcontractors will review and comply with this SSHSP prior to initiating work at the site.

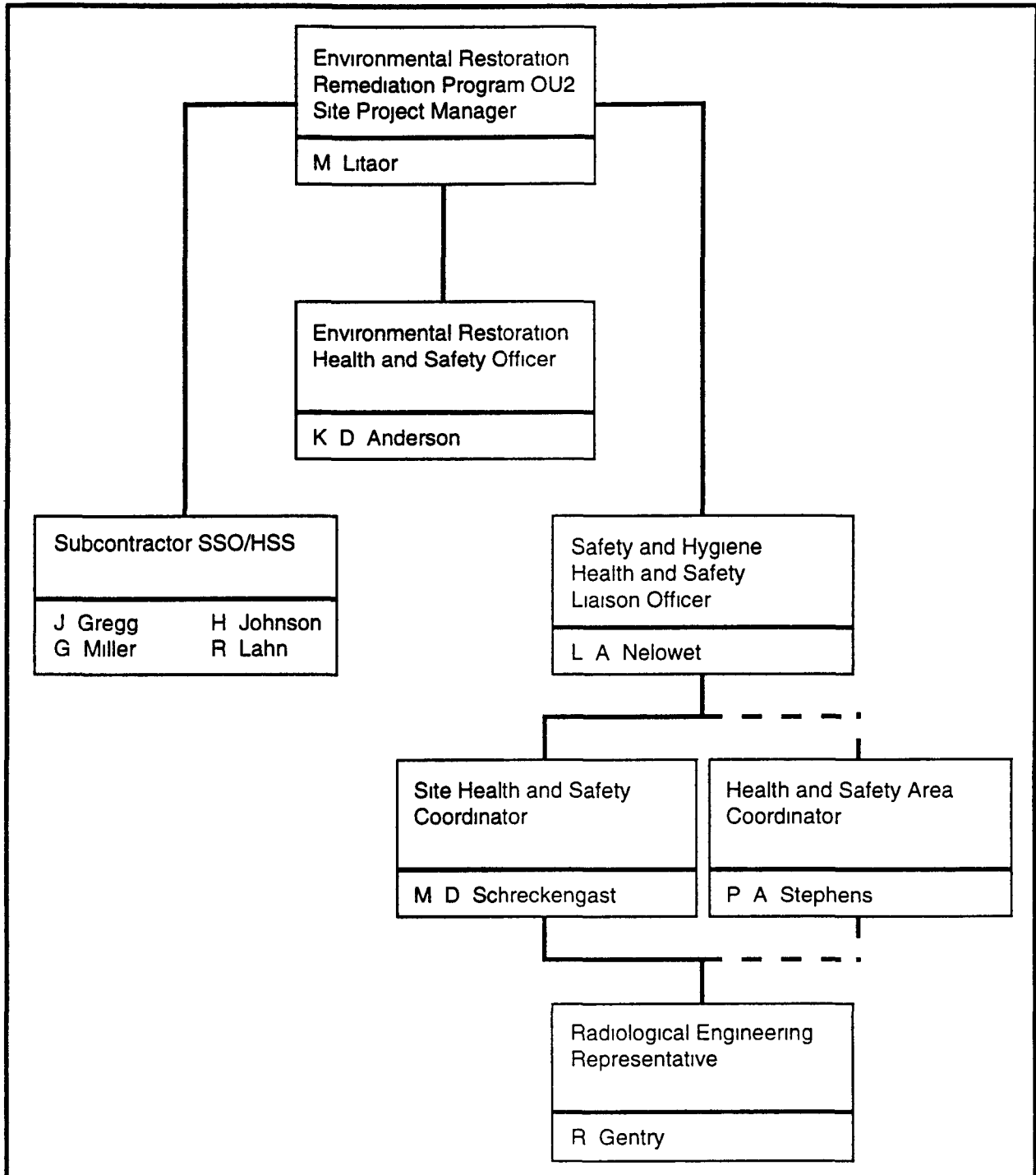


Figure 2 1-1 Safety and Health Organization for Surficial Soil Program (OU2)

2.2.2 Site Safety Officer

The Site Safety Officer (SSO) is responsible for implementing the supplemental SSHSP that adequately addresses the site hazards and controls necessary to safeguard personnel and property. Duties of the subcontractor SSO include the following:

- Providing requisite physical examination requirements to subcontractor employees working at hazardous waste sites,
- Correlating exposure data to ensure that the scope of annual physical examinations are correct,
- Informing employees of potential exposures to hazardous materials based on bio-assays,
- Ensuring that personnel are adequately trained so that they can safely perform their assigned tasks,
- Ensuring that personnel are aware of potential site hazards, and that they know the necessary controls to prevent overexposure or injury by conducting site-specific briefings,
- Appointing alternate SSO(s),
- Ensuring that the SSHSP and the required training and medical records for site personnel are current and are maintained on-site,
- Ensuring that all personnel have read and signed the SSHSP. A copy of the signed SSHSP must be kept in the work trailer,
- Conducting the required monitoring or assuring that monitoring is conducted by the assigned personnel,
- Coordinating with the EG&G Project Manager regarding the need for additional safety support required for the SSP project,
- Performing audits of subcontractor health and safety operations,
- Approving modified work practices in response to changing conditions, and
- Document control and distribution of any revisions to the SSHSP

2.2.3 Health and Safety Specialist

The SSO for the SSP project has the responsibility for assigning an Health and Safety Specialist (HSS) to provide oversight and monitoring of field operations. The key responsibilities of the HSS is

- Monitoring the project to ensure that the requirements of this SSHSP are implemented,
- Alerting the Program Manager and the SSO of health and safety violations,
- Performing tests to minimize the potential for exposure of field personnel and verify that equipment leaving the RCAs or areas of suspected/potential soil contamination is in compliance with applicable regulations and standard operating procedures (SOPs),
- Monitoring soil surfaces and samples and will perform decontamination verification by frisking and smear testing,
- Ensuring that field crews are in compliance with EG&G radiation work permits (RWPs), and
- Performing duties in accordance with the EG&G EMRGs with the approval of EG&G Radiological Engineering

2.2.4 Field Technicians

The field technicians are responsible for implementing and abiding to all provisions of the SSHSP and the supplement specific to this SSP project

2.2.5 Fire Protection Representative

The fire potential during environmental investigations does not justify the cost of providing an independent Fire Protection Representative. Fire prevention is expected to be largely a matter of good housekeeping. In the event of a fire, EG&G Fire Department will be notified and all subcontractor personnel will withdraw from the area. Should any personnel sustain injury, RFP Emergency Medical Services will be immediately notified. The EG&G emergency number is 966-2911.

2.3 SURFICIAL SOIL PROGRAM (SSP) PROJECT PERSONNEL

Project Title	Name (Company)	Phone
Program Manager	Allen Crockett (Stoller)	(303) 449-7220
SSO/HSS	John Gregg (IT)	(303) 793-5200
SSO/HSS	G Miller (Woodward-Clyde)	(303) 694-2770
SSO/HSS	R Lahn (Woodward-Clyde)	(303) 694-2770
Technician	Steve Aldrich (Stoller)	(303) 443-7220

2.4 EG&G PERSONNEL

	Name	Extension
Radiological Engineering Representative	K Gentry	x5151
Industrial Hygiene/Site Health and Safety Coordinator	P Schreckengast	x5471
Environmental Restoration Health and Safety Officer	K Andersen	x8577

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3.0 HAZARD ASSESSMENT

3.1 INTRODUCTION

The field work that will be conducted as part of the SSP includes potential radiological, physical, biological, and mechanical hazards. These potential hazards were identified by reviewing site histories, previous sampling results, and the work plan for the project. The use of standard measures such as PPE, work site radiological monitoring, work practice controls, and training should assist in identifying, evaluating, and controlling potential hazards at the work site that are not currently known.

Based on available information about the site, field work will be conducted in areas where the severity of potential hazards is expected to be low. The potential for encountering radiological hazards will depend on the types of compounds at the site, work practices, and field activities to be performed. Environmental physical and biological hazards, such as insects, heat, and cold stress may be encountered to some degree while working at the site. The degree of mechanical hazards resulting from motor vehicle, field equipment, power tools, etc., will also depend on the work being performed. The rationale for monitoring and PPE are presented in Sections 9.0 and 6.0, respectively.

Field activities at the SSP project will involve the following operations:

- Non-intrusive operations such as assisting in radiological surveys and water sampling from existing installations. These operations do not disturb the soil and are not expected to approach occupational exposure limits.
- Intrusive operations such as installation of snow water instruments. These operations disturb soil and have the potential to re-suspend contaminated subsurface soils. The quantities of spoils produced is small. Dust generation will be minimized by misting soils with water. The Plan for the Prevention of Contaminant Dispersion (PPCD) developed by EG&G addresses dust emissions and will be complied with by Stoller.

3.2 POTENTIAL HAZARDS

3.2.1 Pathways and Exposure Routes

Pathways of exposure to hazards are directly dependent upon investigative activities performed at the SSP site. Exposure to potential health hazards may occur during field activities involving soil interstitial water sampling and other sampling and measurement efforts. Exposure pathways include the following:

- Inhalation of fugitive dust containing radionuclides,
- Skin contact with radionuclides,
- Inadvertent ingestion of dust particles or fugitive dust contaminated with radionuclides, and
- Injection of radionuclides into the body through wounds

3.2.2 Radiological Hazards

3.2.2.1 Airborne Exposures to Radiological Hazards — Exposure to radiological hazards could occur through inhalation of fugitive dust contaminated with radiological materials. The degree of potential exposure to airborne radiological hazards is considered unlikely or low depending on the individual work site and amount of air-borne dust created at the site. Most work sites reportedly have low or below background levels of radionuclides and the intrusive activities to be performed usually generate low quantities of airborne dust. Unknown radiological contamination at the site (e.g., buried contaminated material in the landfill) could lead to unexpected generation of airborne radiological hazards. The use of initial site surveys, air monitoring, work practice controls (e.g., minimizing dust generation), dust control practices, and proper use of PPE, and respirators will be the primary evaluation and control measures used to prevent inhalation of radioactive materials. If an inhalation exposure is suspected the provisions of EMRG 2.2 - Possible Inhalation Exposure will be followed.

3.2.2.2 Skin Exposures to Radiological Hazards — Radioactive materials identified at sites in OU2 are not readily absorbed through the unbroken skin. Contamination avoidance, decontamination, and proper use of protective clothing and gloves will be the primary control methods used to prevent skin contamination.

3.2.2.3 Inadvertent Ingestion of Radionuclides — Ingestion of radionuclides is possible during site work. The potential for exposure via this pathway is considered to be remote if good personal hygiene practices are followed prior to eating, drinking, or smoking. No eating, drinking, smoking, or chewing of tobacco or chewing gum will be allowed in the contamination reduction zone (CRZ) or the exclusion zone (EZ).

3.2.2.4 Puncture Wounds — Radiological materials could enter the body through breaks in the skin caused by a cut, laceration, puncture, abrasion, or burn. This route of entry can be controlled by complying with safe work practices to prevent accidents. If accidents occur possibly leading to radiation exposure, ROI 2.3 or EMRG 2.3 procedure will be implemented.

3.3 PHYSICAL HAZARDS

Workers at SSP sites within OU2 are potentially subjected to physical stresses including heat and cold stress and noise exposure. Investigative activities may take place during a wide range of weather conditions leading to possible heat or cold stress conditions. Unacclimatized workers or workers wearing impermeable personal protective clothing during warm weather may be susceptible to heat stress. The "buddy" system will be used and all personnel shall be aware of the signs and symptoms of heat/cold stress on themselves or their "buddy". High noise exposure is possible when operating power tools and mechanized equipment.

3.3.1 Cold Exposure

When working outdoors in temperatures below freezing, workers are susceptible to frostbite. Exposure to extreme cold can cause severe injury to the body surface or can result in profound generalized cooling, causing death. In cold weather, precautions should be taken to prevent cold.

exposure by wearing properly insulated garments and taking warm-up breaks in temperature controlled areas when necessary Symptoms of cold exposure include the following

- Incipient frostbite or frost nip, characterized by sudden blanching or whitening of the skin
- Superficial frostbite, which causes the skin to become waxy or white and superficially firm, but resilient beneath
- Deep frostbite, characterized by cold, pale, solid skin tissues
- Systemic hypothermia, caused by exposure to freezing or rapidly dropping temperature Symptoms are usually exhibited in stages These include shivering, apathy, listlessness, sleepiness, rapid cooling of the body temperature to less than 95° Fahrenheit (F), unconsciousness, glassy stare, slow pulse and slow respiratory rate, freezing of the extremities, and death

3.3.2 Heat Stress

A worker's risk for developing heat stress is greatly increased when wearing impermeable, personal protection clothing This type of clothing limits the body's normal heat exchange mechanisms and increases energy expenditure A program to recognize potential heat stress situations, prevent episodes, and control hazards will be implemented when the SSO/HSS deems it necessary The program will include heat stress monitoring, adequate rest breaks, fluid replacement, acclimatization, and personal cooling systems Heat stress can cause health effects that range from heat fatigue to serious illness or death Signs and symptoms of heat stress include the following

- Heat rash, which may result from continuous exposure to heat or humid air
- Heat cramps, caused by heavy sweating with inadequate electrolyte replacement Signs and symptoms include muscle spasms, or pain in hands, feet or abdomen
- Heat exhaustion, which occurs from increased stress on various body organs or systems, including inadequate blood circulation due to cardiovascular system inefficiency or dehydration Signs and symptoms include pale, cool, moist skin, heavy sweating, dizziness, nausea, or fainting

Personnel having symptoms of heat exhaustion will be immediately removed from field work. Protective equipment will be removed and vital signs monitored. If body temperature exceeds 101° F the individual will be transported to the medical facility for evaluation.

Heat stroke is the most serious form of heat stress. The body's temperature regulation system fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Signs and symptoms of heat stroke are red, hot, usually dry skin, reduced or lack of perspiration, nausea, dizziness and confusion, strong, rapid pulse, or coma. The body temperature often exceeds 102° F.

If signs of heat stroke are detected, the emergency should be immediately reported by calling 2911. The individual's protective clothing will be removed and they will be cooled by flushing with water that is close to body temperature. The individual will be transported for further evaluation/treatment to the medical facility determined by the responding Emergency Medical Technicians. Appendix B provides additional guidance for the prevention, monitoring, and treatment of heat stress.

3.3.3 Noise Exposure

Workers are not anticipated to be exposed to high noise levels during sampling and maintenance activities of the SSP.

3.3.4 Explosive Hazards

No explosive hazards are anticipated during sampling and maintenance activities of the SSP.

3.4 BIOLOGICAL HAZARDS

Biological hazards that may be present at RFP include plants, insects, and snakes. Considerations for potential biological hazards may be necessary when workers are required to enter remote or seldom-visited locations.

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The potential for contact with snakes or insects that may cause injury or disease exists when performing field activities at RFP. The RFP does not host any plants that are poisonous to humans, other than poison ivy. There are some plants that may be mechanically injurious (i.e., thorns, yucca). Field personnel will wear sturdy work clothes and steel-toed boots in order to help prevent injuries.

There is one type of venomous snake present in the RFP area, the prairie rattlesnake. Personnel should be aware that snakes may be present in the area and exercise caution, especially when working in previously undisturbed areas and locations with animal dens.

Black widow spiders may be present at SSP sites. They are usually found in shady places or under rocks or wood. The black widow spider has a shiny black body about the size of a pea, with a red or yellow hourglass-shaped mark on its abdomen. It weaves shapeless webs in undisturbed areas. A bite may result in severe pain, illness, and possibly death from complications, but usually not from the bite itself.

In addition to spiders, ticks, chiggers, bees, and wasps may be nuisances to field personnel. Bites from wood ticks may result in the transmission of Rocky Mountain Spotted Fever, a serious and possibly fatal viral disease. The Rickettsia virus infects wood ticks, mostly in the late spring and early summer, and is characterized by chills, fever, severe pain in leg muscles and joints, and a body rash. Lyme Disease is not prevalent in Colorado. Some protection will be offered by PPE, but the use of insect repellent (containing at least 30 percent DEET) on outside clothing and exposed skin also may be warranted. Personnel should perform self-searches after each day to check for ticks and chiggers. Bees or wasps can be considerable hazards for those people with allergic reactions to venom. The SSO should be notified if any worker is sensitive to these insects. Properly trained personnel will administer first aid should a bee or wasp sting occur.

3.5 MECHANICAL HAZARDS

Workers may be exposed to potential mechanical hazards during the field activities of the SSP project. Hazards and methods of hazard control are detailed in EG&G SOPs and operation safety

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analyses for specific tasks performed during field activities. Site inspections will be conducted periodically by the SSO to assess hazards according to standard health and safety protocols.

3.6 HAZARD CONTROL METHODS SUMMARY

The control measures listed below are the minimum control measures required for work at the SSP site. Additional control measures may be necessary as determined by site health and safety personnel. As additional site data become available through site monitoring or investigations, the control measures may need to be altered. The decision to alter the control measures will be made by the SSO/HSS.

3.6.1 903 Pad

3.6.1.1 Site Background Summary — Starting in 1958, barrels containing used machining fluids were stored outdoors at the location now called the 903 Pad. Leakage from the barrels was discovered in 1964. By 1968 the last barrels had been removed and the area was monitored for alpha activity. Levels up to 13.5 micro Curies per gram of soil were found, with activity penetrating to 8 inches deep.

3.6.1.2 Anticipated Work Activities — No work will be conducted at the 903 Pad site.

3.6.2 Surficial Soil Program (SSP) Site

3.6.2.1 Site Background Summary — The distribution of radioactive dusts at the RFP has been driven by prevailing west to east wind and drainage patterns. As the existing SSP site is east of both the 903 Pad and the entire RFP, the site has been impacted by historical radionuclides releases.

3.6.2.2 Anticipated Work Activities — Project personnel will conduct non-intrusive activities such as water sampling from existing installations, piezometer readings, site inspection, and radiation monitoring activities at the site.

3.6.2.3 Potential Radiological Hazards — Expected concentrations of plutonium - 239 (Pu239) near the areas of this project are thought to be approximately 0.05 pico Curies per gram (pCi/g). The background concentration is 0.02 pCi/g. Americium-241 is a contaminant of weapons-grade plutonium, present at less than 20 percent of the concentration of Pu239. Uranium-238 is also known to be present in some soils at the site. These radionuclides pose a health hazard due to alpha particle emissions. Alpha (He²⁺) is not sufficiently penetrating to penetrate the dead layers of skin, which means that these radionuclides do not pose an external hazard. However, it is very important to avoid inhalation or ingestion of these compounds as alpha radiation may be very damaging from within the body.

3.6.2.4 Control Measures — The project area has been designated as a RCA Modified Level D protection including cotton coveralls, tyvek coveralls, safety boots, disposable boot covers, eye protection, gloves will be worn during all activities in the RCA. Leather gloves over two layers of latex inner gloves will be worn when handling dry materials to prevent cuts/abrasions. Radiological screening and monitoring in accordance with EG&G SOP FO 16 will be performed during all field work. Decontamination procedures as discussed in Section 7.0 will be followed for general equipment. Face and hands will be washed after leaving the site and before eating, drinking, or smoking.

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4.0 HAZARD COMMUNICATION

4.1 INTRODUCTION

Project personnel and all subcontractors must follow established work practices to safely handle hazardous chemicals. The implementation of a hazard communication program is also required by 29 CFR 1910.120 for RCRA treatment, storage, and disposal facilities. The SSO/HSS will maintain an inventory of hazardous chemicals stored at the project trailer and material safety data sheets (MSDSs) for those chemicals that will be available to employees at the site.

4.2 HAZARDOUS MATERIALS INVENTORY

The SSO/HSS will compile an inventory of hazardous chemicals present at their work sites or trailer areas and provide this information to EG&G Industrial Hygiene Department. The inventory may be requested by emergency response personnel to aid in identifying hazards associated with a spill or accident at the site. Radiological check sources and/or reference sources must also be included in this inventory including applicable calibration certificates.

4.3 MATERIAL SAFETY DATA SHEETS (MSDSs)

The MSDS must be readily available to employees for hazardous chemicals used or stored at the site. Information found on a MSDS includes identification of the product's hazardous chemical constituents, its physical characteristics, applicable exposure limits, symptoms of overexposure, recommended PPE, fire and explosion hazards, and spill response actions. This information is provided by the manufacturer and is typically included with the shipment of the chemical. The EG&G Industrial Hygiene Department maintains a master file of MSDS for materials stored or used at the plant. A complete file of MSDSs for hazardous chemicals used at the SSP project will be kept at the project trailer and readily available to site personnel.

4.4 TRAINING

Project personnel and all subcontractors are required to complete Hazard Communication training as part of their 40-hour OSHA training. Specific training on the information provided in the project MSDSs will be conducted by the SSO/HSS, or, if necessary, by a representative of the EG&G Industrial Hygiene Department. Specific hazards associated with the project will be communicated to workers at the site-specific briefing and then at the weekly safety

5.0 SITE CONTROL

5.1 OBJECTIVES

The purpose of this site control plan is to protect workers, the public, and the environment from the potential hazards associated with the OU2 SSP. In addition to general site control measures required under the 29 CFR 1910.120, activities conducted at SSP shall be conducted in accordance with the EG&G Integrated Work Control Program (IWCP). Project personnel will adhere to requirements of the IWCP. A RWP is required as part of the IWCP in the project area since the area has been designated as a RCA. Information required for the RWP includes job information, description of hazards, radiological and non-radiological safety requirements, preparation for the job, approval signatures, and permit duration.

5.2 SITE CONTROL DESIGNATIONS

The project work area has been designated an RCA and has been roped off and posted as required. This roped off work area itself is designated as an EZ and the staging area outside a work location is designated as a CRZ. Access to these areas will be controlled. Personnel working in the areas must meet specific training requirements, be participants in a medical surveillance program, and wear required PPE. Minimum requirements for access to these designated areas are summarized below. Detailed PPE, training, and decontamination requirements are presented in the respective sections of this plan.

5.2.1 Exclusion Zone (EZ)

The limits of the EZ have been established and marked by yellow rope and postings. The PPE requirements within the zone have also been established based on the hazards of the work being conducted, as determined by the appropriate health and safety representative. Environmental samples collected at these sites may contain elevated levels of radiological contaminants. Personnel entering these areas will be required to wear appropriate PPE. When leaving these areas,

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decontamination procedures (described in Section 7 0) will be followed where required, including clearance by the approved SSO/HSS

The EZ is also an RCA based on the historical data. A RWP and a site access log will be posted at the entrance to the EZ. Entry and exit requirements shall be posted as per ROI 1 03

5.2.2 Contaminant Reduction Zone (CRZ)

Adjacent to the EZ is the CRZ, where appropriate measures will be in effect to reduce the potential for spreading contamination via the workers and equipment. The entrance, exit, and decontamination area adjacent to the EZ will be designated as a CRZ. All personnel conducting or supervising activities in this area are required to have appropriate training.

5.2.3 Support Zone

The Support Zone will be outside the CRZ and will be the area where support workers will provide assistance to workers inside the EZ and CRZ. The Support Zone will begin at the exit from the decontamination line. Only clean or appropriately containerized equipment or material will be allowed to exit into the support zone from the CRZ. Visitors and observers will comply with the site control designations and the zone requirements established at the work site. Visitors will not be allowed to enter the EZ and/or CRZ without training as required in Section 10 0 of this SSHSP.

5.3 COMMUNICATION WITHIN CONTROL ZONES

Personnel will not conduct work activities alone. They will be accompanied by either another employee or subcontractor employee. The buddy system, as specified in 29 CFR 1910.120 (d)(3), will be implemented at the site. The buddy teams working at the site will maintain visual and audible contact so that they can provide emergency assistance to each other, if needed. Both members of the buddy team need not be in the same site zone, but each member must be wearing adequate PPE to assist the other, if necessary.

The communication system at the site consists of hand-held radios. Project personnel will rely on the EG&G hand-held radio system used by personnel performing the project work.

5.4 PLAN FOR THE PREVENTION OF CONTAMINANT DISPERSION (PPCD)

5.4.1 Objective

The objective of the PPCD is to establish procedural requirements to mitigate potential hazards to the general public as a result of contact with emissions resulting from intrusive RI activities.

5.4.2 Scope

Procedural requirements for the prevention of contaminant dispersion, applicable to intrusive actions as part of the RFI/RI activities described in the Interagency Agreement, are described in the PPCD prepared by EG&G. Intrusive activities that fall within the scope of this PPCD are those with the potential for producing suspended particulate, primarily through mechanical actions.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

6.1 INTRODUCTION

The use of PPE is required when engineering and administrative controls are insufficient to prevent worker exposures to radioactive materials. Due to the nature of work performed at OU2, there is a potential for release of contaminated particulates which cannot be completely controlled at the source. Engineering and administrative controls will be used, when appropriate, to minimize potential worker exposures to the site contaminants, however, the use of PPE will be necessary to maintaining exposure as low as reasonable achievable (ALARA).

This PPE program defines the minimum level of protection that has been designated for the SSP project. The contingency protective equipment requirements are also defined. The PPE requirements will be re-evaluated by the site SSO/HSS as the work proceeds and recommendations for modifications to this program will be made to the Program Manager by the project SSO as required.

EG&G personnel, DOE representatives, or other authorized site visitors requiring access into areas zoned as restricted will follow the personal protective equipment requirements set in this plan.

6.2 PPE ISSUES APPLICABLE TO ALL SITE PERSONNEL

All personnel assigned to OU2 and the SSP must be trained in the proper inspection and use of the PPE used on this project before beginning work on the site. This training requirement is fulfilled through completion of the 40-hour OSHA course discussed in Section 10.0, Training, but site-specific training will cover the PPE requirements of this project.

All personnel working on this project who may be required to wear an air-purifying respirator must have a current medical clearance issued by a qualified physician and a fit test certificate for the size and make of respirator used. This clearance will be updated annually with the employee's physical exam as described in Section 8.0 of this plan.

The SSO and individual team members are responsible for the inspection of their own and their team member's equipment during donning and field use. Personnel who are having equipment difficulties or experience tears in their suits should proceed directly to the CRZ for repairs or replacement of their equipment. If an exposure to site contaminants is suspected as a result of equipment failure, immediately contact the SSO or the EG&G Industrial Hygiene Department.

6.3 COMPONENTS OF LEVELS OF PROTECTION

OSHA and the EPA define four levels of protective equipment ensembles in the 29 CFR 1910.120 regulations, Levels A, B, C, and D. Levels A and B specifying the use of self-contained breathing apparatus are not addressed in this plan. If either of these levels of protection are required due to the presence of extreme site hazards, this situation will be handled as a separate amendment to this plan.

The levels of protection that are defined for this project include Level C, Level D, and a modified Level D. The specific equipment that is identified for each of these general ensembles is listed in Table 6.3-1.

6.4 LEVELS OF PROTECTION FOR SITE ACTIVITIES

The minimum safety equipment required for all personnel on this project site includes a hard hat, EG&G coveralls, and steel toed shoes. No workers, visitors or other personnel will be allowed on this project without these safety items even in the non-hazardous areas. Minimum levels of PPE by activity are listed in Table 6.4-1.

All non-intrusive activities will be performed in a modified Level D with skin, hand, and boot coverings. Intrusive activities will initially be performed in Level C (air purifying respirators) until the air quality can be characterized and a lower level of protection can be proposed. The decision to downgrade the level of protection will be made with the concurrence of the SSO, the Program Manager, and the EG&G PM.

Table 6.3-1 Specific Requirements for Each Level of Protection

Level of Protection	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
D	<p>Required</p> <ul style="list-style-type: none"> • Steel-Toed Boots or Shoes • Long-Legged Pants • Safety Glasses or Chemical Splash Goggles <p>Optional, As Required</p> <ul style="list-style-type: none"> • Work Gloves • Coveralls • Hearing Protection 	<p>No respiratory protection</p> <p>Minimal skin protection</p>	<ul style="list-style-type: none"> • The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals 	<ul style="list-style-type: none"> • May be worn in support or the CRZ This level should not be worn in the EZ The atmosphere must contain at least 19.5% oxygen
Modified D	<p>Required</p> <p>All Rqmts of Level D Plus</p> <ul style="list-style-type: none"> • Chemically Protective Suite – Tyvek or Polyethylene Coated Tyvek Inner and Outer Gloves • Chemical-Resistant Safety • Boots/Shoes or Steel-Toed Work Boots with Latex Overshoes (Taped to Suit) <p>Options, As Required</p> <ul style="list-style-type: none"> • Splash Shield • Hearing Protection • Eye Protection 	<p>Increased skin and splash protection, but no respiratory protection</p>	<p>Working in dusty areas or in areas with splash potential where low inhalation hazard is presented</p>	<ul style="list-style-type: none"> • May be worn in the EZ if the area has been demonstrated to be free of air contaminants above the action levels The atmosphere must contain at least 19.5% oxygen
C	<p>Required</p> <ul style="list-style-type: none"> • Full-facepiece, air-purifying respirator equipped with organic vapor and HEPA filter cartridges • Chemically protective clothing dependent on the specific area <ul style="list-style-type: none"> – Tyvek full body suit for dry areas, – Polyethylene coated Tyvek for when splash hazards exist • Inner latex glove and outer nitrile gloves (taped to suit) • Chemical-resistant safety boots/shoes or steel-toed work boots with latex overshoes (taped to suit) • Hard hat • Two-way radio communications <p>Optional, As Required</p> <ul style="list-style-type: none"> • Coveralls under chemically protective suit • Face shield for splash protection • Long cotton underwear 	<p>Respiratory protection up to 50 times the permissible exposure level of selected contaminants (i.e., particulates and some organic compounds), and skin and splash protection from contaminated dust and water</p>	<ul style="list-style-type: none"> • The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air-purifying respirators are met 	<ul style="list-style-type: none"> • Atmospheric concentration of chemicals must not exceed immediately dangerous to life or health levels • The atmosphere must contain at least 19.5% oxygen

Table 6 4-1 Minimum Levels of PPE by Activity

Work Activity	Initial Level of Protection	Additional Comments	Contingency PPE
Project Activities in Non-RCA Areas	Level D	No contact or access to contaminated areas is permitted for personnel in this level of protection	No significant exposures to any of the site contamination is expected
Site Activities in RCA	Modified Level D	Tyvek suits, gloves, and boot covers are required for all access into the EZ regardless of activity	Upgrade to Level C if air monitoring action levels are exceeded (See Section 9 0)
All Intrusive Activities in the EZ	Level C	Tyvek suits can be used during activities with no splash hazards Water sampling and work around the pond requires the use of PVC suits	Downgrade any intrusive activity level of protection if no significant inhalation hazards are posed to workers If upgrade is necessary, contact SSO and PM

6.5 REUSE OF PPE

All disposable protective equipment (Tyvek suits, gloves, etc) must be removed and disposed of whenever a worker leaves the EZ This includes leaving the site after five minutes or a full day The length of the service life of a respirator cartridge, with activated carbon or other chemical adsorbing element, will be determined by the following criteria

- Breathing resistance becomes excessive,
- Chemical odors are detected by the wearer, or
- Dispose of chemical respirators after a minimum of seven days of use, sooner if necessary

Containers will be provided for the disposal of PPE used in the EZ and will be located adjacent to the CRZ Procedures for the use and disposal of PPE are given in SOP FO 6 -Handling of PPE, and shall be strictly followed

7.0 DECONTAMINATION

7.1 INTRODUCTION

The objective of decontamination is to remove hazardous substances from workers and equipment, to assure compliance with DOE Order 5480 11 and OSHA Standard 29 CFR 1910 120, to prevent the spread of contamination from the site, and to prevent potential adverse health effects that could be caused by contact with hazardous materials by unprotected workers

Safe work practices and engineering controls should be undertaken to prevent equipment and personnel from becoming contaminated during the work on this site All equipment, samples, personnel, and vehicles leaving the exclusion zone will be checked for radiological contamination, and effective appropriate decontamination procedures will be undertaken to remove any contamination prior to release of the equipment from the site

The decontamination of personnel and equipment will be performed in the contamination reduction zone at the exit to the exclusion zone Protective equipment and respirators will be removed in this area Containers will be provided for collection of disposable protective clothing

7.2 DECONTAMINATION PROCEDURES

7.2.1 Personnel and Small Equipment Decontamination

The hazardous materials known to be present at the site are radionuclides It is the responsibility of the SSO to determine whether radiological contamination of personnel or equipment exists and to prescribe the decontamination procedures that will be required Appropriate PPE will be used during decontamination operations as an additional measure to prevent direct employee exposure to hazardous substances

Current EG&G SOPs should be consulted for specific decontamination requirements. These procedures include SOP FO 03 - General Equipment Decontamination, SOP FO 06 - Handling of PPE

Respirators will be frisked and smeared for contamination prior to removal and cleaning. If radiological contamination is discovered on the exterior of the respirator, it should be removed before washing or disinfecting the face piece. (Head should also be frisked if respirator is found to be contaminated.) Respirators should be wiped clean by site personnel as they are removed. They must be stored in a plastic bag, with the cartridge side down, so that distortion of the facepiece does not occur.

7 2.2 Surface Contamination Surveys

The purpose of the surface contamination surveys will be to control and document all property/material to be released from the RCA. All equipment which leaves the RCA must be surveyed and comply with the EG&G Property Release Evaluation form. Radiological screening will be performed by the project SSO or by project personnel trained in performing this function.

8.0 MEDICAL SURVEILLANCE

8.1 MEDICAL MONITORING REQUIREMENTS

All field personnel and all subcontractors participating in the soil sampling of interstitial waters shall adhere to a medical monitoring program which fulfills the requirements of 29 CFR 1910 120. The program includes:

- Baseline Medical Examination Including Bioassay for Radionuclides
- Annual Medical Examination
- Exit Medical Examination
- Incident Specific Examination

8.2 AVAILABILITY OF MEDICAL SERVICE

The EG&G Occupational Health Department is located in Building 122. The full staff is on duty from 7 30 am to 4 00 p m Monday through Friday. The registered nursing staff is on duty from 6 30 a m on Monday through 10 00 p m on Friday except 11 00 p m to 6 30 a m (midnight shift). A physician and a nurse are always on call for any emergency during off hours. Weekend coverage (Friday from 10 00 p m through Monday at 6 30 a m and midnight shift coverage) is provided by emergency medical technicians. They can be contacted at extension 4336 and will meet employees in the Occupational Health Department or respond to the site of any emergency. For life threatening emergencies, call extension 2911.

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8.3 TRANSPORTATION FOR MEDICAL REASONS

EG&G and EG&G-subcontractors employees will be provided transportation for medical reasons (if it is medically safe, as determined by the EG&G Occupational Health Staff) to their home or to an appropriate medical facility for the following

- An emergency EG&G Occupational Health will determine the appropriate mode of transportation for illness/injury requiring air or ground ambulance transport
- A non-emergency If there is no medical necessity for ambulance transport, supervisors will be asked to arrange transportation

In a situation where an employee is injured and requires non-ambulance transport to an off-site medical facility, the SSO will accompany that person and be available to interface with outside authorities (if necessary) and to provide further transportation for the employee as appropriate. If personnel are unable to arrange transportation on weekends or during night work they will contact the EG&G Shift Superintendent (RFP Emergency Coordinator) at extension 2914 for assistance.

8.4 MEDICAL RECORDS

EG&G and EG&G-subcontractors are required to keep medical information of an individual's file, including laboratory reports, electrocardiogram reports, x-ray reports, health histories, physical examinations, letters, and reports from the employee's personal or referral physician.

The medical records of all field personnel will remain in the possession of their corporate headquarters and will not be taken from the premises except for the purpose of answering subpoenas.

If respiratory protection is required at the site, the physician must provide authorization that the employee is medically qualified to wear a respirator and this record will be kept at the project trailer by the SSO. EG&G and EG&G-subcontractor personnel required to wear a respirator will be fit tested annually.

9.0 RADIOLOGICAL SCREENING PROGRAM

9.1 DIRECT-READING INSTRUMENTS

Direct-reading or real-time monitoring instruments provide instantaneous data on the concentration or identity of radiological contaminants present on the site

The following direct reading instruments will be used during this project (Also See Table 9 1-1)

- A Bicon Frisk-Tech with A-100 probe will be used to monitor dry equipment surfaces and dry PPE for the presence of alpha-emitting radioisotopes
- A Ludlum 12 with a 44-9 pancake probe will be used to monitor equipment and PPE for the presence of beta- and gamma-emitting radioisotopes
- Bicon Frisk-Tech with B-50 (optional)

Table 9 1-1 Direct-Reading Action Limits

Instrument	Monitoring Guidelines	Instrument Reading	Mandatory Action
Bicon Frisk-Tech with A-100 Probe	Survey All Personnel and Equipment Leaving EZ	0 – 100 CPM	No special precautions
		> 100 CPM	The material is considered contaminated and cannot be released from the EZ, contact SSO

9.2 REAL-TIME RADIOLOGICAL MONITORING

Radiological monitoring involves the detection and measurement of alpha, beta, gamma, or neutron radiation. Radiological monitoring is established in accordance with appropriate and relevant requirements and policies. The goal of the radiation monitoring program is to maintain personnel exposure ALARA. Personnel and equipment contamination surveys will be performed in accordance with the appropriate EMRGs or ROIs.

Monitoring of personnel and equipment for radiological contamination will be performed in the following situations

- Whenever leaving a RCA,
- Whenever exiting a contaminated area,
- During and after work where the potential exists for release of radioactive material,
- Whenever passing through an RCA,
- Following personnel decontamination,
- When required by EG&G SOPs,
- When required by a RWP, or
- When required by the EG&G HSPM, Section 18 10 "Release of Property for Conditional and Unrestricted Use"

9.3 PERSONNEL RADIATION MONITORING

All field personnel on this project will be involved in the RFP personnel radiation dosimetry program during site activities. The program entails the use of personal radiation dosimeters coupled with laboratory analyses to determine the radiation doses experienced on the site. Badges will be provided to each worker and turned into the dosimetry office at specified frequencies. EG&G will be responsible for providing thermoluminescent dosimeters, analyses of dosimeters, and reporting the results to the site SSO. Results will be given to employees, kept in health and safety files, and maintained by each contractor.

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10.0 TRAINING

All EG&G & EG&G-subcontractor personnel assigned to the SSP must complete the training required by OSHA as well as site-specific health and safety training courses required by EG&G (See Table 10-1) The soil sampling of interstitial waters is an environmental investigation classified as a hazardous waste operation by OSHA standard 29 CFR 1910 120, therefore, the training requirements, including the initial training, annual refresher training, and supervisor training, apply to EG&G & EG&G-subcontractor personnel working at the site Additional training courses required by EG&G include General Employee Training, radiation worker, and respirator training

10.1 TRAINING REQUIREMENTS

10.1.1 Hazardous Waste Site Health and Safety

Any EG&G or EG&G-subcontractor employee assigned to work on the SSP must complete the 40 hour hazardous waste health and safety course required by OSHA in 29 CFR 1910 120(e) The 40-hour course and 3 days of supervised field experience is mandatory for workers who may be required to use respiratory protection equipment and/or who are engaged in activities in which they may be exposed to hazardous substances and health hazards at or above the permissible exposure limits

All hazardous waste workers must complete an annual 8-hour refresher course The course content consists of a summary of the 40-hour course Supervisors of hazardous waste sites or of tasks conducted on hazardous waste sites must complete an additional 8-hour supervisor health and safety training course A summary of training requirements is given in Table 10 1

Table 10-1 1910.120 Training Requirements for SSP

Operation/Personnel	Site Safety Briefing	24-Hour	40-Hour	8-Hour Supervisor	8-Hour Refresher
Routine or Occasional Site Worker	Yes	Yes ³	Yes	N/A	Yes
Routine or Occasional Site Worker (Support Zone)	Yes	N/A	N/A	N/A	N/A
Onsite Supervisor	Yes	Yes ⁴	Yes	Yes	Yes
Visitor ^{1,2} • Level A or B PPE	Yes	N/A	Yes	N/A	Yes
• Level C PPE	Yes	Yes	N/A	N/A	Yes
• Level D or No PPE	Yes	N/A	N/A	N/A	N/A
¹ All visitors should be issued and instructed in the use of required PPE, receive a site-specific safety briefing, and be escorted by training personnel ² Visitors are not directly involved with hazardous waste operations (i.e., management, audit, and oversight personnel) Visitors include those covered and not covered by OSHA ³ 24-hour training is adequate for these workers only for entry into areas where Level D PPE is sufficient For routine workers, the area must also have been monitored and fully characterized ⁴ Supervisors of general site workers who require only the 24-hour course need only take the 24-hour initial and 8-hour supervisor courses					

10.1.2 Radiation Worker Training

All subcontractor personnel performing field work must complete the 1-day class entitled "Radiation Safety for Environmental Restoration" offered by the EG&G Performance Based Training Department Starting January 1, 1994 all site personnel must either test out or complete a 3 day EG&G Radiation Worker Level II Training Course

10 1.3 Site-Specific Briefing

All subcontractor employees assigned to work on the SSP project must receive a briefing that introduces site safety, emergency procedures and the information contained in the plan. The briefing should provide enough detail that employees can implement the plan and safely perform their assigned tasks.

Visitors who do not have the required OSHA training and medical certifications will not be allowed to enter the site EZ or CRZ. Prior to gaining access to the site, visitors to the SSP site will have an orientation that summarizes the plan. This orientation does not qualify the visitor to access-controlled areas of the site. The purpose of the briefing is to provide sufficient information on the hazards and control measures at the site to prevent the visitor from unknowingly violating any site control measures. Visitors will be escorted by a trained site employee during the entire visit.

Visitors will provide signature verification that they have read, understand, and will comply with the requirements of the plan. Signatures are recorded in a logbook, which is maintained at the project trailer by the SSO.

10.1.4 Safety Meetings

Discussion at weekly meetings may include the following topics:

- Health and safety considerations and the required PPE for current operations,
- Any revisions to the plan,
- Any new MSDS filed at the project trailers,
- Documented or observed unsafe acts committed at the worksite, a clarification of the safety requirements violated, and methods to prevent future violations, and
- Approved changes to the plan.

Workers are required to attend the weekly safety meetings and sign a roster (attendance sheet) that will be maintained by the SSO at the project trailers. Meeting minutes will be documented and attached to the roster. The project manager or HSO will review the meeting minutes with absentees and have them sign the attendance sheet. This documentation will be filed at the work site,

available to EG&G upon request, and archived when the project is completed. Safety meetings will be conducted weekly at a minimum or more frequently as necessary.

10.1.5 Rehearsal of Emergency Response Plan

Subcontractor personnel will participate in any Emergency Response Plan rehearsals conducted by EG&G Emergency Preparedness.

10.2 VERIFICATION OF TRAINING

The SSO will maintain documentation of EG&G and EG&G-subcontractor employee training (including supervised field experience) on file at the project trailers. These records will be kept on file by the SSO.

11.0 EMERGENCY INFORMATION

11.1 NOTIFICATION

LIFE-THREATENING EMERGENCIES CALL EXTENSION 2911

NON LIFE-THREATENING EMERGENCIES CALL EXTENSION 2914

Notification requirements for emergency situations at SSP depend on the nature of the perceived emergency (e g , spill injury, illness, fire) and the extent to which the damage and/or injuries have progressed Upon discovery of a release of materials or other non life-threatening emergency situation, the Shift Superintendent will be notified at extension 2914 If there is no answer at 2914, refer to 2911 If the situation is life-threatening, RFP emergency response personnel will be notified as detailed below

Call Extension 2911 to obtain emergency assistance for life-threatening emergencies and to simultaneously access the following

- Emergency Coordinator (EC), Shift Superintendent
- Plant Protection Central Alarm Station
- Fire Department Dispatch Center
- Medical Department

As much detail about the emergency as possible will be provided. A decision to dispatch any or all of the following equipment will be based on the provided information.

- Fire Engine
- Ambulance
- Hazardous Material (HAZMAT) Response Vehicle

Provide the following information, upon request, to the Emergency Dispatcher

- Informant's Name
- Exact Location of the emergency
- Nature of the emergency
- Condition of the patient if applicable (breathing, consciousness, bleeding, etc.)
- Special hazards in the area
- Any other information requested

If no details are given, emergency response personnel will respond automatically.

The EC will immediately respond to emergencies. The RFP Protection Central Alarm Station will activate the Building Emergency Support Team by the Life Support/Plant Warning Public Address System. The EC will activate the Emergency Operation Center and notify departments that have an advisory role in the situation, if applicable. The EC will determine whether additional help from off-site agencies (e.g., police, hospitals) is required.

The EC will also notify the following groups when appropriate:

- Radiological Engineering
- Industrial Hygiene
- Industrial Safety
- Waste Operations
- Waste Programs

- Traffic
- Occurrence Notification Officer
- Health and Safety Administrator

11.2 SPECIFIC SITE HAZARDS

The response to and abatement of most emergency situations from the SSP will require the expertise of RFP emergency response personnel. Situations that will require the assistance of RFP emergency responders include, but are not limited to the following:

- Accidents resulting in physical injury,
- Accidents resulting in radiological exposure,
- Incidents where the substance cannot be absorbed, neutralized or otherwise controlled at the time of release,
- Situations where there is a potential for safety or health hazards
- Accidents resulting in a radiological exposure exceeding the following limits
 - 2 rem (Whole Body)
 - 7.5 rem (Skin)
 - 15 rem (Extremities)

11.3 SPILLS OF HAZARDOUS AND RADIOACTIVE MIXED WASTE AND HAZARDOUS MATERIAL

REPORT TO THE EC AT EXTENSION 2911 all spills where the substance cannot be absorbed, neutralized, or otherwise controlled at the time of release, or where there is a potential for safety or health hazards (fire, explosion, chemical, or radiological exposure). The EC will dispatch the HAZMAT Response Vehicle and any other necessary support personnel.

Spills that do not require a HAZMAT response shall be cleaned up by site personnel according to an approved EG&G SOP. Spills onto porous ground will require removal of contaminated dirt as

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well as the spilled material and are expected to be classified as hazardous and radioactive mixed waste

11.4 POST-EMERGENCY RESPONSE EQUIPMENT MAINTENANCE

Equipment used in emergency situations will be decontaminated by wiping with a soap solution. Rags used for decontamination will be disposed as low-level radioactive waste, if necessary. Contaminated heavy equipment used in emergencies will be thoroughly decontaminated prior to being released from the site. The decontamination protocols described in SOPs FO 10 - Heavy Equipment Decontamination, FO 11 - Handling of Decontamination Water and Wash Water, and FO 18 - Decontamination Facility Operations will be followed. Equipment will not be released until monitoring indicates that contaminant levels are less than 20 disintegrations per minute/100 square centimeters (above background) and that chemical contamination is not present.

11.5 EMERGENCY EQUIPMENT LOCATION

A 15-minute emergency eye wash and shower will be provided for tasks where eye hazards may exist. Either a 15-minute eye wash will be located within 100 feet or 10 seconds of travel time from each hazard area or a portable hand-held eyewash bottle will be available at the site for use. These items may be located in the project trailers on the site. Fire extinguishers will be located in all field vehicles and will be temporarily located at sites where there is a potential for fires (e.g., during welding operations). First aid will be provided by EG&G Emergency Medical Technicians.

11.6 EVACUATION PLAN

Personnel and visitors to SSP will evacuate the area if any of the following occur:

- If an emergency (such as a fire or chemical spill) develops
- If instructed by site supervision
- If instructed by the Shift Superintendent over the site radio or telephone system

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After an evacuation, each Field Team Leader will verify that the employees that he/she supervises are accounted for

11.7 COMMUNICATION

Radios will be used by field personnel to maintain contact with the project manager or other designated persons in the trailers who have access to telephones. The HSO and PM will monitor the radio frequency in use by field personnel at all times during field operations. Radio frequencies are monitored by the RFP security system to ensure that response time is minimal in the event of an accident or emergency on the site. In the event of a plant emergency, Central Dispatch will notify the trailers and field personnel by telephone and radio. If Central Dispatch fails in its attempt to contact anyone on-site, a security car will be sent to the site to alert personnel of the emergency.

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12.0 REFERENCES

EG&G 1991 *Environmental Management Radiological Guidelines*

EG&G 1993 *Final Site-Specific HSP for the Phase I RCRA Facility Investigation/ Remedial Investigation OU2*

EG&G 1993 *Request for Competitive Proposal - Task Order #MTS 343788DB3 - DMM-235-93 "SSP at RFP"*

Health and Safety Plan (HASP) Addendum Cleanout and Decontamination of Wooden Shed

(Addendum to "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program)

Prepared by John W. Gregg / [Signature] Site Safety Officer, Surficial Soils Program / 03/16/94 /
Name Signature Title Date

Introduction

This HASP addendum covers activities to be performed during the cleaning, decontamination, and interior painting of the wooden shed currently located approximately ten feet east of the eastern boundary of the OU2 Amencium Zone area used by the Surficial Soil Program. All activities described in this HASP addendum will be conducted in accordance with this addendum, and with the Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program.

Objective

The shed is to be cleaned and painted, prior to it being utilized as a storage shed for Soil Science Program equipment and supplies. This will involve removal of insulation, removal of rodent droppings and nests, and interior decontamination of the structure. It is intended to perform these activities between 3/17/94 - 3/25/94.

Hazard Assessment

Biological

Various biological hazards may be present in the shed due to the presence of rodent droppings and dried rodent urine in the shed. Hantavirus, otherwise known as "Four Corners Virus", is a primary concern. Hantavirus is an infectious disease transmitted primarily by the droppings and/or dried urine of infected rodents. Human infection can occur by inhalation of aerosols of these materials, by direct contact with these materials in eyes, other mucous membranes or broken skin, or by ingestion. Infected humans initially exhibit flu-like symptoms. The disease can progress quickly, however, and possibly lead to respiratory failure and death.

Chemical

Vapors will be generated by the spraying of decontamination solution (solution of household bleach and water) and paint on the interior walls of the shed.

Physical

Heat Stress preventative guidelines detailed in "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soils Program" will be followed. Poor visibility will result from use of full face respirators. Work will be planned in advance prior to donning respirators and personnel will maintain verbal communication ability at all times. If hand-tools are required, only manually-operated or battery-powered hand tools will be used. One team member will maintain "firewatch" on the gasoline-engine pressure sprayer while it is in use.

Tasks

The following steps are expected to be performed, in the order in which they are presented.

- 1 Spray down of all interior walls, shelving and wooden cabinet with a disinfectant solution (nine parts water mixed with one part household bleach)
 - 2 Removal of shelving from interior walls
 - 3 Removal of wooden cabinet from interior wall
 - 4 Removal of all insulation from interior walls
 - 5 Sweeping/shoveling rodent droppings and nesting materials
- If after the above steps are performed, the shed appears to be in a condition suitable for use, the remaining steps will be performed.
- 6 Replace shelves and cabinet
 - 7 Spray painting of all interior surfaces, shelving and wooden cabinet
 - 8 Caulking or other minor repair of holes through which rodents may attempt re-entry into the shed

Personal Protective Equipment (PPE)

Due to the possibility of encountering Hantavirus, as well as due to the vapors that will be generated by the spraying of the structure, Level C PPE will be worn by all personnel working within the shed. Level C PPE will consist of the following:

- 1 Full face twin cartridge respirators (MSA)
- 2 Cartridges appropriate to the task. MSA GMC-H cartridges (organic vapor, acid gas, HEPA) will be worn during the removal of insulation and droppings, and during spraying of the disinfectant solution and paint. GMC-H cartridges provide protection against chlorine vapors.
- 3 DOE coveralls and underwear
- 4 PVC steel toed boots
- 5 Yellow poly-coated tyvek with hood
- 6 Nitrile inner surgical gloves
- 7 Nitrile/latex outer gloves (disposable leather gloves will be worn over outer nitrile/latex gloves if handling sharp or heavy materials is required)

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- 8 Wrist and ankle seams, as well as the facepiece to tyvek hood seam, will be sealed with duct tape
Note Cartridges will be replaced daily, at a minimum, or immediately if "loading" or "breakthrough" is detected

Decontamination

-Equipment / Trash

- 1 All tools used within the structure will be thoroughly sprayed with the same disinfectant solution used to spray the interior walls. The tools will then be washed in a liquinox/water solution and then rinsed in plain water
- 2 Insulation and rodent droppings will be placed in clear plastic trash bags and sprayed with the disinfectant solution prior to sealing the bags

-Personnel

- 1 Prior to removal of PPE, personnel will spray each others PPE with disinfectant solution, taking care not to spray directly onto respirators
- 2 Respirators will be hand wiped with disinfectant solution -soaked paper towels prior to removal. The respirators will then be sprayed with water to prevent degradation of the facepiece material
- 3 Personnel will remove PPE in the following order
 - duct tape from all seams
 - outer gloves
 - tyvek coveralls
 - respirator
 - PVC boots
 - surgical gloves
- 4 Respirators will be cleaned in MSA cleaner - sanitizer and rinsed in clean water before re-donning. Used PPE will be placed and sealed in clear plastic trash bags. It is anticipated that PPE generated during these activities will not be radioactively contaminated
- 5 Personnel will wash hands and face prior to drinking water. No consumables other than water will be allowed or provided in the Support Area. Personnel will discard DOE - issue clothing and shower in the contractors' yard shower trailer prior to utilizing contractors yard toilet facilities, returning to the site trailer or to leaving RFP

Manpower

It is anticipated that two persons (John Gregg - IT Corp, Steve Aldridge - S M Stoller Corp) will require two days to complete the task

Equipment / Chemicals

The following equipment will be or may be utilized to accomplish the tasks described above

- 1 Small hand tools - hammers, drills, etc
- 2 Garden sprayers
- 3 Household bleach
- 4 Water
- 5 Enamel paint
- 6 Gasoline - engined pressure sprayer
- 7 Gasoline safety can
- 8 Fire extinguisher
- 9 MSA cleaner sanitizer
- 10 Drinking water, water cooler, paper cups
- 11 Paper towels, plastic trash bags

MSDSs will be available in the Stoller trailer for all chemicals used on this project

Approved by	<u>L A Melowet</u>	<u>L A Melowet</u>	<u>Health & Safety Liaison Off.</u>	<u>3/17/94</u>
	Name	Signature	Title	Date
Approved by	<u>J L Anderson</u>	<u>J L Anderson</u>	<u>Env. Restoration Biological Engineer</u>	<u>3/17/94</u>
	Name	Signature	Title	Date
Approved by	<u>Michael L. Loran</u>	<u>Michael L. Loran</u>	<u>Sgt. Sergeant</u>	<u>03/18/94</u>
	Name	Signature	Title	Date

Steve H. Aldridge 4-22-94
John Gregg 4-22-94

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Health and Safety Plan (HASP) Addendum #2
PLANNED INTRUSIVE ACTIVITIES DURING SPRING - SUMMER, 1994
and CHANGE IN PERSONAL PROTECTIVE EQUIPMENT

(Addendum to "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program)

Prepared by John W. Gregg [Signature] Site Safety Officer, Surficial Soils Program / 05/03/94 /
Name Signature Title Date

Introduction

This HASP addendum covers planned intrusive activities to be performed during the Spring and Summer, 1994, in the OU2 Americium Zone area under investigation by the Soil Science Program. This addendum also covers a proposed change in Personal Protective Equipment permitted for use in the investigation area. All activities described in this addendum will be performed by or at the direction of Soil Science Program personnel. All activities described in this addendum will be conducted in accordance with this and other approved addendums, and with the Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program.

Change in Personal Protective Equipment (PPE)

Upon final approval of a revised version of Field Operating Procedure F O 6 (Handling of Personal Protective Equipment), DOE-issue white cotton coveralls as an outer protective garment will be approved for wear in the investigation area. DOE-issue surgical scrubs will be approved for wear as a precautionary garment to be worn under the white cotton coveralls when in the investigation area, and as an outer garment when in non-RCA areas. The white cotton coveralls will replace white uncoated tyvek, and the surgical scrubs will replace DOE-issue grey coveralls. All other PPE as described in the Supplement to Site-Specific Safety and Health Plan will remain unchanged. If DOE-issue white coveralls or surgical scrubs are unavailable, if site conditions require, and until the revision to F O 6 is approved, PPE as described in the Supplement to Site-Specific Safety and Health Plan will be worn.

Description of Planned Intrusive Activities

- 1 A pickup-truck mounted hydraulic soil coring rig will be driven into the Americium Zone. The rig will remove soil cores approximately four inches in diameter and approximately fifteen inches long. Instruments will be placed at the bottom of each hole and the soil core will be placed into the original hole. Between four to ten cores will be removed and replaced.
- 2 Hand digging of one or two holes, each approximately five to ten feet in diameter by two feet deep. A soil core "plug" will be removed from the center of one hole, instruments placed at the bottom of the hole, and the soil plug will be replaced. Remaining excavated soils will be hand backfilled into the original hole. The second hole will be required if a counterweight system is required to suspend the soil plug. It is currently planned however to suspend the soil plug using a tripod and winch system during the instrument installation.
- 3 Hand augering and All Terrain Vehicle - mounted power augering of between forty to one hundred - one inch diameter holes for piezometer, tension sampler and tensiometer installation. Depths will range from four inches to twelve feet.
- 4 Hand driving a metal stake approximately twenty centimeters deep to create a hole for instrument probe insertion. Approximately one hundred holes will be driven in a grid pattern over the entire Soil Science Program work area.

Note: It is not anticipated that the intrusive activities described above will result in the generation of waste materials.

Hazard Assessment

Wildlife

No wildlife hazards in addition to those addressed in the Supplement to Site-Specific Safety and Health Plan are anticipated as a result of the planned intrusive activities.

Chemical

No chemical hazards in addition to those addressed in the Supplement to Site-Specific Safety and Health Plan are anticipated as a result of the planned intrusive activities.

Physical

Heat Stress preventative guidelines detailed in "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soils Program" will be followed. All gasoline powered equipment will be equipped with a fire extinguisher. Operation of gasoline powered intrusive equipment will require at least two persons in attendance, one of whom will be assigned as "firewatch". Personnel will be cautioned to be aware of and stay clear of moving machinery. Wheels of

vehicles driven into the investigation area will be chocked and the emergency/parking brake (if present) will be engaged. Powered equipment will be inspected by Occupational Safety prior to being utilized on plantsite. Intended work sites will be investigated for the presence of overhead and underground utility lines prior to the commencement of intrusive activities.

Radiological

It is anticipated that the planned intrusive activities will result in little to no dust emissions. Any soils brought to the surface will be wetted with a portable pump sprayer to minimize dust emissions. Emission of visible dust that is not immediately controllable by wetting the area will result in a halting of activities and re-evaluation of procedures. Need for use of airborne particulate monitoring instrumentation is not anticipated.

Personal Protective Equipment (PPE)

It is anticipated that the PPE described above will be sufficient to perform the planned intrusive activities, as well as all other planned site activities described in the Supplement to Site Specific Safety and Health Plan. Upgrade of PPE, if necessary, will be performed at the direction of the Site Safety Officer (examples: when or if wetting soils to prevent fugitive dust emissions results in excessively muddy conditions, if handling of chemicals requires greater protection than that provided by coveralls or uncoated tyvek). Use of respirators (level C PPE) is not anticipated. If conditions requiring upgrade to level C are encountered, activities will be halted and procedures will be re-evaluated.

Radiological Contamination Monitoring / Decontamination

-Equipment

Equipment performing intrusive activities will be decontaminated to the extent possible within the work area (brushing off loose dirt, soap/water brush, water rinse). Radiological contamination monitoring will then be performed for total fixed plus removable and removable alpha and beta/gamma contamination. If contamination levels are below the allowable limits for unrestricted release, the equipment may then be released to the project trailer by the Health and Safety Specialist (HSS). Large equipment requiring unrestricted release off plantsite will first be decontaminated and surveyed as described above, and if contamination levels permit, will then be transported to the Main Decontamination Facility for precautionary decontamination and further monitoring. Equipment leaving the OU2 Americium Zone for release off plantsite and / or equipment with complex surfaces leaving the Americium Zone will require notification of and approval by Radiological Engineering prior to removal from the Americium Zone and from plantsite.

-Personnel

Personnel monitoring and decontamination procedures as described in the Supplement to Site-Specific Safety and Health Plan remain in effect.

Approved by	<u>Michael Lee</u>	<u>Michael Lee</u>	<u>Paul Schickel</u>	<u>6-9-94</u>
	Name	Signature	Title	Date
Approved by	<u>KD Anderson</u>	<u>[Signature]</u>	<u>ERHSO</u>	<u>6-10-94</u>
	Name	Signature	Title	Date
Approved by	<u>RC Gentry</u>	<u>[Signature]</u>	<u>Health Physicist</u>	<u>6-13-94</u>
	Name	Signature	Title	Date
Approved by	<u>LA Niland</u>	<u>[Signature]</u>	<u>HSLO</u>	<u>6-13-94</u>
	Name	Signature	Title	Date
Approved by	<u> </u>	<u> </u>	<u> </u>	<u> </u>
	Name	Signature	Title	Date

I have read the contents of this HASP addendum and agree to comply with the requirements stated within.

John Gregg [Signature] 6/14/94

Dale Anderson [Signature] 6/14/94

G. BARTH [Signature] 6/14/94

[Signature] 8-15-94

(Additional signatures on reverse side):

United States Government

Department of Energy
Rocky Flats Field Office

● memorandum

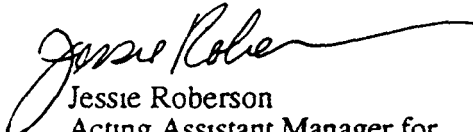
DATE JUN 15 1994

REPLY TO
ATTN OF ER DJ 06689

TO: Sue G Stiger, Associate General Manager
Environmental Restoration Management
EG&G Rocky Flats, Inc

The Department of Energy Rocky Flats Field Office Acting Assistant Manager for Environmental Restoration (AMER) has reviewed your request for interim use approval of Procedure FO 06, "Handling Personal Protection Equipment. The AMER hereby grants limited interim approval for use, with the following stipulations

- Interim use only applies to the use of cloth coveralls in lieu of Tyvek for the purpose of reducing the possibility of heat related stress in personnel,
- The use of cloth coveralls in lieu of Tyvek is approved by appropriate Health and Safety groups, and
- Only coveralls screened as uncontaminated shall be permitted to go to the laundry. Any contaminated coveralls shall be handled as hazardous/radioactive/mixed waste per the current version of FO 06 (Rev 2, March 1, 1992)


Jessie Roberson
Acting Assistant Manager for
Environmental Restoration

cc
D Joseffy, NFT
K Bentzen, EG&G

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Health and Safety Plan (HASP) Addendum #3

Change in Personal Protective Equipment (PPE)

(Addendum to "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program)

Prepared by John W. Gregg [Signature] Site Safety Officer, Surficial Soils Program / 05/13/94 /
Name Signature Title Date

Soil Science Program personnel entering the OU2 Americium Zone will have available reusable PVC steel toe boots to wear as an alternate to yellow latex "nuke boots". The PVC boots will be fnsked for alpha and beta contamination prior to personnel exiting the Americium Zone. If no contamination is found, the boots will be placed upside down in a wooden boot rack for re-use the following work day. If contamination is found, the boots will be decontaminated or disposed of. Contaminated boots will not be re-used. Use of reusable boots should present no added risk of radiological exposure to personnel as compared to "nuke boots", and will result in a significant cost savings to the project. Yellow latex "nuke boots" will remain available for wear by project personnel, if necessary.

Approved by RC GENTRY [Signature] Health Physicist 5/13/94
Name Signature Title Date

Approved by L.A. Nelawet [Signature] H.S. Liaison Officer 5/16/94
Name Signature Title Date

Approved by K.D. Anderson [Signature] ERHSD 6/9/94
Name Signature Title Date

Michael Lita Michael Lita Soil Scientist 05/20/94

EG&G HASP FIELD CHANGE FORMField Change Number OU 2 CS/SNP-94-001Effective Date 07/11/94Requested by K. D. Anderson
(Print Name)K. D. C.
Signature/DatePen and Ink changes to be made to the HASP to alert the reader of this change

Change #1. Due to additional tasks being conducted under the OU 2 Surficial Soil Program, the tasks identified below must be included in Section 1.4 of the Supplement to Site-Specific Safety and Health Plan, Operable Unit No. 2, Surficial Soil Program.

Reason for the change to be incorporated into the HASP:

Any additional tasks must be identified in a project's health and safety plan. Therefore, tasks for the Evapotranspiration Rates in the Rocky Flats OU 2 Zone must be identified in the Supplement to Site-Specific Safety and Health Plan, Operable Unit No. 2, Surficial Soil Program.

Text of change to be incorporated:

Section 1.4, Second Paragraph, First Sentence, change. "The six tasks..." to "The eleven tasks..." at the beginning of the sentence.

Section 1.4, Second Paragraph, First Sentence, change. "." to "." at the end of the sentence.

Section 1.4, Second Paragraph, After Sixth Bullet, add the following bullets to the paragraph, that is, add.

- conduct evapotranspiration studies
- installation and support of a Class-A evaporation pan and various weather instruments
- measure weather data and evapotranspiration rates
- monitor and record weather evapotranspiration data
- conduct intrusive work to include soil excavation

APPROVALS

K. D. C. 7/7/94
ERHSO/Date M.D. Schreckengast for
K.C. Rodenbaugh 7-7-94
H&S Liaison Officer/Date
Michael L. Fer 7/7/94
Unit Manager/Date

AS NEEDED CONCURRENCE

[Signature] 7/8/94
Occupational Safety
[Signature] 7/7/94
Radiological Engineering
M.D. Schreckengast 7-7-94
Industrial Hygiene
[Signature] N/A
Occupational Health - N/A
Fire Department N/A
Radiological Operations

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Health and Safety Plan (HASP) Addendum #4
PLANNED INTRUSIVE ACTIVITY, SUMMER - FALL, 1994

(Addendum to "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program)

Prepared by John W. Gregg / [Signature] / Site Safety Officer, Surficial Soils Program / 08/29/94 /
Name Signature Title Date

Introduction

This HASP addendum modifies a planned intrusive activity to be performed during the Summer and Fall of 1994 in the OU2 Amencium Zone area under investigation by the Soil Science Program. This activity, described in HASP addendum #2 (see attached) as "hand digging of one or two holes, each approximately five to ten feet in diameter by two feet deep" has been changed. All activities described in this addendum will be performed by or at the direction of Soil Science Program personnel. All activities described in this addendum will be conducted in accordance with this and other approved addendums, and with the Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program.

Description of Planned Intrusive Activity

1. Excavation of two holes, each approximately six feet by six feet square, by three and one half feet deep. The bulk of the excavation will be performed with a small rubber tired backhoe. Minor excavation will be performed manually with a pick and shovel in order to prepare each excavation for placement of instrumentation. A "core" of soil, thirty eight inches in diameter, will initially be left undisturbed at the center of each excavation. Excavated soil will be placed to the side of each excavation on plastic sheeting.
2. The center soil "cores" will be separated from the underlying soil by insertion of a metal plate horizontally through the cores at the bottom of each excavation. It is anticipated that the metal plates will be driven through the cores using a hydraulic jack. The soil cores will then be lifted from the excavations by the backhoe. It is intended to attach heavy cargo straps from the metal plates at the bottom of the cores to the backhoe bucket. The soil cores will be temporarily placed to the side of each excavation.
3. Concrete will be hand mixed and poured into the center of each excavation, forming slabs approximately forty inches in diameter by four inches thick. Lysimeter instrumentation will then be placed in the excavations atop each slab, and the soil cores will be lifted by the backhoe into place on top of the instrumentation. Excavated soils will then be backfilled into the remaining areas of the excavations.

Hazard Assessment

It is anticipated that the hazards related to intrusive activities as described in HASP addendum #2 will be applicable to this task. HASP addendum #2 will be used in conjunction with this addendum.

Additional Physical Hazards

It is anticipated that the only hazards specific to this task not previously discussed in the HASP or the HASP addendums are physical hazards related to the backhoe and excavations. The following steps will be taken to ensure worker safety.

1. The backhoe will be operated by a selected Soil Science Program staff member with previous experience operating backhoes and other heavy equipment on construction sites.
2. The backhoe will be inspected by EG&G Occupational Safety prior to being utilized on plantsite.
3. When being driven on paved roads on plantsite, the backhoe will be escorted by a project vehicle with blinkers flashing.
4. All movement of the backhoe within the Amencium Zone will be performed under the direct supervision of the Site Safety Officer, with the approval of the EG&G Project Manager.
5. All backhoe excavation activities will be performed under the direction of the Principle Investigator for this activity and under the supervision of the Site Safety Officer.
6. At no time will personnel be allowed to approach the backhoe from a direction unseen by the operator.
7. Sides of the excavations will be sloped to prevent collapse of material into the excavations, and excavated materials will be deposited at least two feet from the sides of each excavation.
8. Only limited amounts of concrete will be mixed. The need for respirators to protect against breathing concrete mix particulates is not likely. However, personnel mixing concrete as well as personnel in the immediate vicinity will be respirator fit tested and respirators will be available in the field if required.

Radiological Contamination Monitoring / Decontamination

The provisions described in Hasp addendum #2 are applicable and remain in effect for this activity.

Approved by W.D. HARLOW / [Signature] / Safety Eng IHS / 9-12-94 /
Name Signature Title Date

Approved by RC GERRY / [Signature] / Health Physicist IV / 9-13-94 /
Name Signature Title Date

Approved by KD Anderson / [Signature] / ER HSO / 9-13-94 /
Name Signature Title Date

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Approved by H.M. DANIELS for M.Z. LITAO / [Signature] / SOIL SCIENCE TEAM LEADER / 9/14/94 /
Name Signature Title Date

Health and Safety Plan (HASP) Addendum #5

MODIFICATION TO PLANNED INTRUSIVE ACTIVITY, FALL, 1994

(Addendum to "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program)

Prepared by John W. Gregg [Signature] Site Safety Officer, Surficial Soils Program / 10/14/94 /
Name Signature Title Date

Introduction

This HASP addendum modifies a planned intrusive activity to be performed during the Fall of 1994 in the OU2 Amencium Zone area under investigation by the Soil Science Program. This activity, described in HASP addendum #4 as using cargo straps attached to a backhoe bucket to lift a soil "core" has been changed. All activities described in this addendum will be performed by or at the direction of Soil Science Program personnel. All activities described in this addendum will be conducted in accordance with this and other approved addendums, and with the Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program.

Description of Intrusive Activity Accomplished To Date

Excavation by hand of one hole, approximately six feet in diameter by two feet deep. A "core" of soil, approximately three feet in diameter, has been left off-center within the excavation. The center soil "core" has been separated from the underlying soil by utilizing a hydraulic jack to drive steel channels horizontally through soil at the bottom of the core.

Description of Modification to Intended Remaining Activities

It had been intended to attach heavy cargo straps from the steel channels at the bottom of the core to the lifting hook of a backhoe bucket. The backhoe would then have lifted the soil core out of the excavation, placing it temporarily to the side while the interior of the excavation was outfitted with instrumentation. The backhoe would have then placed the soil core back into the excavation, directly on top of the measuring instrumentation. Due to the unavailability of a suitable backhoe and trained operator, the use of a backhoe to accomplish the lifting of the soil core is not possible.

It is now planned to use a forklift with a hoisting attachment to lift the soil core from the excavation. The forklift and trained operator will either be provided by EG&G or its subcontractor, Golder and Associates. The forklift hoisting attachment will either be provided by EG&G or will be obtained through an offsite vendor. The forklift will hoist the soil core with cargo straps attached to the steel channels and hoisting attachment by heavy duty eyelets and clevises. The cargo straps have been rated by the vendor for vertical loads in excess of ten thousand pounds each.

Hazard Assessment

It is anticipated that the hazards related to this activity as described in HASP addendums #2 and #4 will be applicable to this task. HASP addendums #2 and #4 will be used in conjunction with this addendum.

Additional Physical Hazards

It is anticipated that the only hazards specific to this task not previously discussed in the HASP or the HASP addendums are physical hazards related to the forklift itself. The following steps will be taken to ensure worker safety:

1. The forklift will be operated by a selected EG&G or EG&G subcontractor employee with previous experience operating forklifts.
2. All movement of the forklift within the Amencium Zone will be performed under the direct supervision of the Site Safety Officer, with the approval of the EG&G Project Manager.
3. All forklift hoisting activities will be performed under the direction of the Principle Investigator for this activity, and under the supervision of the Site Safety Officer.
4. The Principle Investigator, the Site Safety Officer, and the forklift operator will each inspect the hoisting attachment, the cargo straps, and all eyelet and clevis attachments prior to hoisting the soil core. Each person must give their approval that the core is ready for hoisting prior to commencement of the activity.
5. At no time will personnel be allowed to approach the forklift from a direction unseen by the operator.
6. At no time will personnel be allowed to approach the soil core close enough to be struck by it or the cargo straps while it is being hoisted.

Radiological Contamination Monitoring / Decontamination

The provisions described in Hasp addendum #2 are applicable and remain in effect for this activity.

Approved by K.C. Gentry [Signature] Health Physicist / 12-13-94 /
Name Signature Title Date

Approved by W.D. Harlow [Signature] ESH Administrator / 12-13-94 /
Name Signature Title Date

Approved by L.A. Levee [Signature] H+S Liaison, OFFICE / 12-13-94 /
Name Signature Title Date

Approved by K.P. Anderson [Signature] TERNISO / 12-13-94 /
Name Signature Title Date

Approved by M.C. Lital [Signature] [Signature] / 12-13-94 /
Name Signature Title Date

May 19, 1995

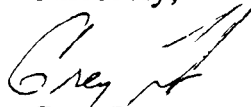
Mr Roland Geroncin
University of Colorado
Health Physics Lab
Campus Box 441
Boulder, CO 80309

Dear Mr Geroncin,

Attached for you review is the procedure that will be used to prepare and transport samples prior to viewing them in the Geology Building Laboratory As described in the procedure, a conservative estimate of the likely $^{239/240}$ Plutonium and 241 Americium activities in each one milliliter sample is 0.023 picocuries and 0.003 picocuries respectively.

This procedure has been reviewed and approved by EG&G Rocky Flats I believe that you will also find the procedure satisfactory for performing the proposed work If you have any questions or concerns please call me as soon as possible (966-5790) so that they can be addressed prior to the May 24, 1995 committee meeting

Sincerely,


Greg Litus

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Scientific Notebook

Sample Preparation and Handling Procedure

Project Description

This investigation is part of the ongoing study of the mobility of $^{239/240}$ Plutonium (Pu) and 241 Americium (Am) in soils near the 903 Pad at the Rocky Flats Environmental Technology Site (Rocky Flats). Preliminary results from previous experiments at the soil study site (Site) show that there is a rapid increase in groundwater levels during rain simulations. This rapid increase may be associated with preferential flow and has the potential to transport Pu contaminated soil particles into the groundwater.

To further characterize the fate and transport of Pu and Am into groundwater, the investigation includes the following components. First, the groundwater at the Site will be collected using dialysis cells and analyzed for actinides, metals, major anions, and other water quality parameters. Results from this phase of the investigation will establish ambient groundwater quality conditions. Second, both vadose zone water and groundwater samples will be collected in conjunction with measurements of groundwater recharge during controlled rain simulations. The analytical results from these samples and the recorded fluctuations in groundwater will be used to assess the quality of the water responsible for recharge to the alluvial aquifer. Third, synthetic microspheres will be applied to the surface of the study area. Movement of these microspheres into the subsurface as a result of rain simulation will establish the pathway for migration of soil particles from the surface to the subsurface. The extent of the microsphere migration, if any, will be used to determine the importance of groundwater recharge through soil macropores.

Microsphere migration will be measured by fluorescent microscopy. Aliquots of collected samples will be viewed using a Leitz Laborlux D microscope fitted with a mercury light source and the appropriate light filters to excite the fluorescent properties of the microspheres. This equipment is located in room 108 of the Geology Building at the University of Colorado in Boulder.

This investigation will be conducted during the 1995 Spring and Summer field season with the results expected in early 1996.

Sample Preparation

All sample preparation will be conducted in the designated radiological controlled area (RCA) in Trailer 891L at Rocky Flats. Water samples collected at the soil study site will have 10 milliliter aliquots taken for microsphere analysis. From each sample aliquot approximately one milliliter of homogenized water will be placed on an etched glass slide and slowly evaporated under a heat lamp. The remaining residue will be covered with a glass slip. The glass slip will then be sealed to the glass slide with a paraffin bead.

After the samples are prepared, the exterior of each slide will be surveyed for fixed plus removable and removable radiological contamination by the project health and safety officer. Only samples that meet unrestricted released limits per the EG&G Rocky Flats Environmental Remediation Management Guideline 3.02 will be transported to the University of Colorado for viewing.

There will be no sample preparation at the University of Colorado laboratory and cover slips will not be removed. A estimate of the likely $^{239/240}$ Plutonium and 241 Americium activities in each 1 ml sample is 0.23 picocuries and 0.03 picocuries respectively. These values were calculated using the maximum analytically determined activity of each isotope in groundwater at the study site.

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400 VALLEY ROAD
WARRINGTON, PA. 18976
(215)343-6484

SAFETY
DATA
SHEET

date 05/19/95

SECTION I IDENTIFICATION

Product Name: FLUORESBRITE MICROSPHERES, PLAIN AND CARBOXYLATE, 2.5% SOLIDS
Chemical Name:

SECTION II HAZARDOUS INGREDIENTS DATA

Hazardous Components:

None. This material has no hazards declarable under 29 CFR, 1200.

SECTION III PHYSICAL DATA

Appearance and Odor : OPAQUE LIQUID, WHITE OR DYED; NONE

POLYSCIENCES, INC. HAZARD CODE: A2dmw

* POLYSCIENCES, INC. provides the information contained herein in good *
* faith but makes no representation as to its comprehensiveness or *
* accuracy. Individuals receiving this information must exercise their *
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* or to which the information refers. Accordingly POLYSCIENCES, INC. *
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* reliance upon this information. *

SPECIAL PRECAUTIONS

Precautions to be Taken in Handling and Storage: Store at 4 deg. C.
Keep storage container tightly closed. Avoid contact with skin and eyes
Do not inhale. Wash thoroughly after handling.

TOTAL P 02

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Transportation and Sample Custody

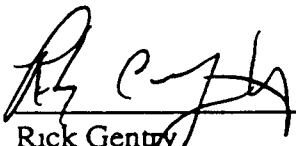
Prepared slides will be placed in plastic slide boxes. Slide boxes will then be placed in an unmarked hand-held cooler along with a sample custody form. The custody form will include the sample number associated with each slide and the total number of slides in the cooler. A maximum of 50 slides will be transported at any one time.

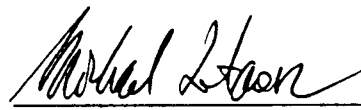
Sample Storage and Disposal


All slides that have been viewed will be stored in the EG&G Soil Science Program sample storage Connex RCA at Rocky Flats. Slide disposal will be consistent with Rocky Flats procedure. No samples will be disposed of in any location other than Rocky Flats.

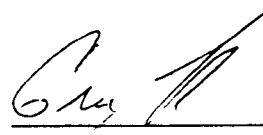
Slide Viewing

Slide viewing at the University of Boulder Laboratory will be limited to normal laboratory hours. All sample handling procedures as required under the University of Colorado radiological licenses and prescribed by the University of Colorado Radiological Health Department will be explicitly followed.


Rick Gentry
Radiological Engineering


Dr. Iggy Litaor
Project Manager


John Gregg
Project Health and Safety Officer


Greg Litus
Principle Investigator

Health and Safety Plan (HASP) Addendum #6
PLANNED SITE DECOMMISSIONING ACTIVITIES DURING LATE '95 & EARLY '96 and
REDUCTION IN THE BUDDY SYSTEM REQUIREMENT
(Addendum to "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2,
Surficial Soil Program)

Prepared by Steven W. Aldridge Steven W. Aldridge Radiological Control Technician/ 10/25/95
Name Signature Title Date

Introduction

This HASP addendum covers planned site decommissioning activities to be performed during late '95 and early '96, in the OU2 Amencium Zone area after the termination of the Soil Science Programs research activities. This addendum also covers a proposed reduction in the buddy system requirement for personnel in the former research area. All activities described in the addendum will be conducted in accordance with the Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program.

Addition of Decommissioning Activities Task

An additional task will be added to this HASP's previous eleven tasks, this is a site decommissioning activities task. The planned site decommissioning activities consist of following activities: disassembling the soil and meteorological monitoring equipment, general site cleanup and radiologically surveying equipment and trash out of the OU2 Amencium Zone Soil Contamination Area.

Reduction of the Buddy System Requirement

Due to the extensive hazard characterization of the site and to the non-intrusive activities of the decommissioning task it has been determined that the buddy system is not necessary for personnel entering the OU 2 Amencium Zone. This only applies to individuals who have constant radio communications access while in the area. Individuals scheduled to work in the field will notify Environmental Restoration Operations personnel by radio (frequency ER-COM) prior to initiating any field activities. The E R Operations personnel to be contacted are Andrea Casillas or Ty Vess, they can also be reached by phone at X5302 and X6540, respectively. During the decommissioning process it will be necessary to move and/or work with sealed lead acid marine deep cycle batteries and also to work with exposed soils, in these cases though infrequent the buddy system will be required for these activities.

Changes in the Personal Protective Equipment (PPE)

The changes in the type of PPE required in the OU2 Amencium Zone will be detailed in the new Radiation Work Permit (RWP) for the Soil Contamination Area.

I H Approval Peggy Schmuckengast Peggy Schmuckengast PMRS Health and Safety 10-26-95
Name Signature Title Date

Rad Engineer Approval S. Anderson [Signature] Health Physics 10/26/95
Name Signature Title Date

C T R Approval Gary R. Kowalski [Signature] PMRS Permitting Mgr. 10-26-95
Name Signature Title Date

Health and Safety Plan (HASP) Addendum #8
RMRS SITE DECOMMISSIONING ACTIVITIES DURING SEPTEMBER AND OCTOBER 1997
and ACTIVITY HAZARD ANALYSIS (AHA) FOR ACTIVITIES
(Addendum to the "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program")

Prepared by	<u>Steven Aldridge/</u> 	<u>/RMRS Site Supervisor/</u>	<u>9-9-97</u>
	Name	Signature	Title
			Date

Introduction

This HASP addendum covers planned site decommissioning activities to be performed during September and October 1997, in the Pad 903 Lip Area of the terminated Surficial Soils Program (SSP) Soil Contamination Area (SCA) site. This addendum covers the RMRS activities for removal of SSP instrumentation and miscellaneous debris. All activities described in this addendum will be conducted in accordance with the Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program and its previous addenda.

Objectives

The Surficial Soil Program instrumentation and debris will be dismantled and removed from the area without any intrusive activities. This will involve preparing the site by cutting the tall vegetation to make access easier and safer, removal and radiological survey of instrumentation and debris, disposal of debris to the landfill, inventory of instrumentation and final dispositioning of instrumentation to a connex in contractor yard.

Tasks

The following tasks will be performed to accomplish the site decommissioning:

- 1 Cutting down overgrown vegetation by site laborers with Weed Eaters
- 2 Disconnecting and disassembling of SSP instrumentation and debris by site laborers
- 3 Radiological survey and onsite release of instrumentation and debris by site Radiological Control Technicians (RCTs)
- 4 Cleaning and disinfecting of possible mouse infested tool cabinet and instrumentation boxes by site laborers. Laborers wearing Air Purifying Respirators (APR) with MSA GMC-H cartridges, will spray down all interior surfaces of cabinet and boxes with a disinfectant solution (nine parts water mixed with one part household bleach) described in addendum "Clean out and Decontamination of Wooden Shed", 3/16/94. Once the cabinet and/or boxes are disinfected, personnel will sweep out the tools and mouse debris onto plastic where the tools can be segregated. Mouse debris will be bagged and dispositioned to the landfill. PPE requirements for this activity in addition to APR will be DOE coveralls, inner nitrile gloves, outer long cuffed nitrile gloves, steel toe shoes and boot covers or steel toed PVC boots. At the discretion of the Site Safety Officer, additional personal protection equipment (PPE) may be added for splash protection if necessary. Decontamination will be conducted in accordance with Addendum "Clean out and Decontamination of Wooden Shed", 3/16/94, Decontamination section. The Hazard Assessment for this activity is covered in Addendum "Clean out and Decontamination of Wooden Shed", 3/16/94.
- 5 SSP platforms and associated debris will be disassembled, surveyed and loaded into trucks to be sent to the landfill by onsite trucking personnel.
- 6 Site Supervisor will inventory all SSP instrumentation.
- 7 All released instrumentation will be transported by onsite trucking personnel to the contractors yard and stored in a connex.

Changes in the Personal Protective Equipment (PPE)

The changes in the type of PPE required in the SCA are detailed in the Radiological Work Permit (RWP) number 97-549-6260, and includes Modesty Clothing (DOE cotton coveralls), 2 pairs of Surgeon Gloves (Nitrile Gloves), and Shoe Covers.

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Personnel requirements

It is anticipated that 3 to 4 laborers, 3 to 4 RCTs, 2 truckers and 1 RMRS Site Supervisor / Site Safety Officer will be needed to complete these tasks

Equipment and Chemicals

The following equipment will be or may be utilized to accomplish the tasks described above

- 1 Small hand tools - hammers, saws, etc
- 2 Garden Sprayer
- 3 Household bleach
- 4 Water for drinking and decontamination
- 5 Weed Eaters
- 6 Generators
- 7 Gasoline
- 8 Gasoline safety cans
- 9 Fire extinguishers
- 10 MSA Full Face APRs
- 11 Drinking water cooler and paper cups
- 12 Paper Towels, plastic bags, PPE and trash

Additional equipment may be necessary but not called out here

Unanticipated Hazards

Unanticipated hazards or conditions encountered during this project will be managed in accordance with this RMRS policy statement "In the event unanticipated hazards or conditions are encountered, the project activities will pause to assess the potential hazard or condition. The potential hazard or condition will be evaluated to determine the severity or significance of the hazard or condition and whether the controls on the project are sufficient to address the hazard or condition. Based on this initial evaluation, a determination will be made whether to proceed with controls currently in place, segregate the hazard or condition from the project activity, if it can be done safely, or curtail operations to address the unexpected hazard or condition. Concurrence to proceed down the selected path must be obtained from the the RMRS Project Manager and the RMRS Vice President or their designee. In addition, the resumption of field activities involving radiological issues will be in accordance with Article 345 of the RFETS Radiological Control Manual." **Note:** "Unanticipated Hazards or Conditions" do not replace conditions, which require emergency response, rather, they ensure that all work is performed based on an informed approach in regards to all potential hazards

The following sections list possible "Unanticipated Hazards or Conditions" and the corresponding response action. Each individual workers has the right to stop work due to unanticipated hazards or conditions and report to the RMRS Site Supervisor or RMRS Management per RMRS Operations Order 001-Notification

Equipment Radiological Contamination >Transuranic Release Limits

All material and equipment exiting the SCA will be surveyed per ROI-3 01. Should any survey results indicate contamination levels greater than those in the RFETS Radiological Control Manual, Table 2-2 the following actions will be taken

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- All activities will be immediately suspended and RMRS Site Supervisor and RMRS Project Manager or designee will be notified,
- RFETS Radiological Engineering will be notified,
- The source of the contamination will be identified and controlled,
- The contaminated material or equipment will be contained, handled, and transferred in accordance with HSP-18 10, "Radioactive Material Transfer and Unrestricted Release of Property and Waste",
- Based on the survey results, the area radiological postings, RWP, controls, and work practices will be reviewed and modified as necessary, and
- Upon approval from the RMRS Project Manager the RMRS Vice President or their designee, and when applicable the Site Radiological Control Manager, work activities will resume

PPE or Personnel Radiological Contamination

If contamination levels are detected on PPE or personnel, as confirmed with the AP-2, the following actions will be taken

- All activities will be immediately suspended and RMRS Site Supervisor and RMRS Project Manager or designee will be notified,
- RFETS Radiological Engineering will be notified,
- Depending on the location and level of contamination the, appropriate actions will be taken to protect the contaminated PPE, the individual, and personnel in the area,
- Personnel with detectable DOE radiological contamination (per ROI 2 01) on skin or on personal clothing will be transported to Bldg 122 for decontamination,
- The source of the contamination will be identified and controlled,
- Based on the contamination levels, the area postings, RWP, and work practices will be reviewed and modified, and
- Upon approval from the RMRS Project Manager the RMRS Vice President or their designee, and when applicable the Site Radiological Control Manager, work activities will resume

Change In Personnel Identifications

Radiological Control Technician (RCT) will replace the "Supplement to Site-Specific Safety and Health Plan, Operable Unit No 2, Surficial Soil Program" designation for Health and Safety Specialists (HSS) The RCTs will be responsible for radiation monitoring activities

Site Laborers will replace the Field Technicians for the above described activities

RMRS personnel will replace Stoller and Walsh designated personnel An organization chart and Emergence phone list for RMRS personnel will be attached

Change to the Heat Stress and Cold Monitoring Guidelines

Heat stress monitoring will be completed using an Imaging and Sensing Technology, Model RSS 214, (and/or equivalent) Heat Stress Monitor The instrument is a microprocessor based Wet Bulb Globe Thermometer (WBGT) which accurately measures environmental factors, which contribute to heat stress The WBGT reading displayed by the instrument, in either Fahrenheit or Celsius, is a weighted sum of the dry bulb, wet bulb, and Vernon globe temperatures The WBGT is calibrated prior to use on a daily basis

and a yearly factory calibration and servicing is recommended. Daily calibration will be per the manufacturer specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. Maintenance is minimal with only the wet bulb wick requiring periodic replacement. Monitoring frequency will depend on the work area temperature, the type of work being performed, and the type of PPE worn. See Appendix A for guidance and action levels for work involving the use of personal protective equipment. Readings in the field will be logged on the Daily WBGT Log. Personnel heat stress monitoring may be conducted in conjunction with WBGT monitoring especially for unacclimated workers.

Cold Stress Monitoring

Cold stress monitoring will be accomplished by obtaining the air temperature and the wind speed and calculating the equivalent chill temperature using the ACGIH table found in Appendix A. Once in the field, wind speed, temperature, and equivalent chill temperature will be logged on the Daily Wind Speed/Cold Stress Log.

Activity Hazard Analysis

Activity Hazard Analysis for the activities described above will be attached.

RMRS Project Manager Approval	<u>IAN PATON</u>	<u>[Signature]</u>	<u>9/11/97</u>
	Name	Signature	Date
RMRS I H Approval	<u>M D Schreckengast</u>	<u>[Signature]</u>	<u>9-11-97</u>
	Name	Signature	Date
SSOC Rad Engineering Approval	<u>H. B. ESTABROOKS</u>	<u>[Signature]</u>	<u>9/11/97</u>
	Name	Signature	Date

**RMRS Pad 903 Lip Area SCA Surficial Soil Program Site Decommissioning and
Instrumentation Removal Project**

Activity Hazard Analysis

9-97

Activity	Hazard	Preventative Measures
All site activities	General work hazards	<ul style="list-style-type: none"> • All personnel will wear steel-toed shoes, safety glasses with side shields, and hearing protection as applicable. Hard hats will be worn during overhead work. The SSO will determine when hard hats are required.
	Heat stress	<ul style="list-style-type: none"> • Heat stress monitoring will be conducted in regards to work load and PPE worn as applicable.
	Cold stress	<ul style="list-style-type: none"> • Cold stress monitoring will be conducted as applicable. • Proper clothing will be available to all personnel and administrative controls will be adhered to.
	Noise	<ul style="list-style-type: none"> • Noise monitoring will be conducted as applicable. • In high noise area (>85dBA) personnel will wear hearing protection. • All personnel will participate in the RFETS Hearing Conservation Program if necessary.
Traversing the site	Slip, trips, falls	<ul style="list-style-type: none"> • Care will be taken when traversing the site especially when carrying equipment. • All trip hazards will be immediately removed or marked when identified.
Lifting equipment and materials	Back injury	<ul style="list-style-type: none"> • Proper lifting techniques will be used.
Handling equipment and materials	Pinch points and sharp edges	<ul style="list-style-type: none"> • Care will be taken when pinch points and sharp edges exist and heavy-duty leather work gloves will

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**RMRS Pad 903 Lip Area SCA Surficial Soil Program Site Decommissioning and
Instrumentation Removal Project(Continued)
Activity Hazard Analysis**

Activity	Hazard	Preventative Measures
		be worn
Cutting vegetation	Flying debris	<ul style="list-style-type: none"> Personnel will be required wear safety glasses or goggles while cutting weeds with Weed Eaters
	Noise	<ul style="list-style-type: none"> Personnel will be required to wear hearing protection
	Fire	<ul style="list-style-type: none"> At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool Fuel containers will be electrically bonded to the light plants and generators during refueling
	Use of gasoline	<ul style="list-style-type: none"> Follow recommendations on MSDS (see Appendix B)
Using hand tools and power hand tools to disassemble SSP instrumentation	Hand tools in unsafe operating condition	<ul style="list-style-type: none"> The user prior to each use will inspect hand tools Defective tools will be tagged and taken out of service
	Improper use of hand tools	<ul style="list-style-type: none"> Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Improper electrical connections	<ul style="list-style-type: none"> All electrical wiring and connections will be performed by a experienced technician
	Electrical shock	<ul style="list-style-type: none"> Portable power tools will be plugged into a GFCI protected

**RMRS Pad 903 Lip Area SCA Surficial Soil Program Site Decommissioning and
Instrumentation Removal Project(Continued)
Activity Hazard Analysis**

Activity	Hazard	Preventative Measures
		<p>outlet and will be UL listed with three pronged ground plug or double insulated</p> <ul style="list-style-type: none"> • Cords will be inspected by the user and protected from unnecessary damage • Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators to power portable power tools	Electrical shock	<ul style="list-style-type: none"> • Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage • Any extension cords, which show signs of damage or deterioration, will be immediately removed from service
	Electrical shock	<ul style="list-style-type: none"> • Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded • The user daily prior to the beginning of each shift will test the GFCI
	Fire	<ul style="list-style-type: none"> • At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator • All refueling will be conducted at the beginning of the shift when the generators are cool • Fuel containers will be electrically bonded to the light plants and generators during refueling

**RMRS Pad 903 Lip Area SCA Surficial Soil Program Site Decommissioning and
Instrumentation Removal Project(Continued)
Activity Hazard Analysis**

Activity	Hazard	Preventative Measures
	Use of gasoline	<ul style="list-style-type: none"> Follow recommendations on MSDS (see Appendix B)
Disinfecting tool wooden cabinet and wooden instrumentation boxes	Exposure to the Hantavirus	<ul style="list-style-type: none"> Personnel will be required to wear MSA full face respirators with GMC-H cartridges Protective gloves will be worn when contacting possibly contaminated material
	Use of chlorine Bleach	<ul style="list-style-type: none"> Follow recommendations on MSDS (see Appendix B)

Approved:

Signature

Date

RMRS Project Manager Ian Paton

Ian Paton 1 9/11/97

RMRS Site Supervisor/Site Safety Officer-Steven Aldridge

Steven Aldridge 1 9/11/97

RMRS H&S Supervisor-Peggy Schreckengast

Peggy Schreckengast 1 9/11/97

SSOC Radiological Engineer-Bates Estabrooks

Bates Estabrooks 1 9/11/97

APPENDIX A

HEAT AND COLD STRESS GUIDELINES

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INTEROFFICE
MEMORANDUM

DATE July 8, 1996
TO Distribution
FROM Ricky J Carr, Environmental Safety & Health, Bldg T664A, X2970
SUBJECT HEAT STRESS - RJC-014-96
Action None Required

The purpose of this memo is to provide guidance regarding the prevention and monitoring of heat stress conditions. It should be noted that heat stress related conditions or disorders (i.e. heat stroke, heat exhaustion) are considered to be occupational illnesses by OSHA and therefore are recordable cases. It is incumbent to prevent, monitor and mitigate conditions which may lead to heat stress among employees.

There is a draft Heat Stress Program that has been written by Kaiser-Hill L.L.C. (K-H) Industrial Hygiene and Safety and reviewed by the Industrial Hygiene and Safety organizations of the major subcontractors. This Heat Stress Program describes the responsibilities of various personnel regarding implementation of the Program and contains instructions for monitoring heat stress and provides guidelines for Threshold Limit Values (TLVs) and work/rest regimens. DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees requires compliance with the most recent edition of the ACGIH "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices" when TLVs are more protective than OSHA Permissible Exposure Limit (PELs) (there is no OSHA PEL for heat stress). The work/rest regimens specified in the Heat Stress Program are based upon the ACGIH TLVs modified by professional judgment for the use of impermeable personal protective clothing (PPE). These TLVs assume that the workers exposed to heat stress conditions are acclimatized.

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It is (will be) Rocky Mountain Remediation Services (RMRS) policy to adhere the requirements of the Heat Stress Program including the work/rest regimens contained as Appendix 1 of the Program (attached). Prevention of potential heat stress conditions is the first method to be considered when heat stress is identified as a potential hazard associated with any activity or task. Prevention methods to be considered include work schedule, modification of task/activity and provision for rest areas. The Heat Stress Program provides instructions for monitoring heat stress conditions using the Wet Bulb Globe Temperature (WBGT) Index. WBGT accounts for air temperature, relative humidity, and solar load and provides a mechanism for correlating environmental conditions with body temperature and other physiological responses to heat stress. The Heat Stress Program contains a Table for work/rest regimens based upon the WBGT Index, work activities, and level of Personal Protective Equipment (PPE). Work/rest regimens shall be established in accordance with guidelines in the Table with the following interpretations. Physiological monitoring (i.e. body temperatures, pulse rates) will be performed whenever practical and feasible in order to verify the work/rest regimens are appropriate considering the WBGT Index. The use of personal cooling devices such as ice vests or vortex cooling can be used to modify the WBGT Index.

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RJC-014-96
July 8, 1996
Page 2

for a particular work activity and level of PPE. The WBGT Index can be lowered by 3°F if a personal cooling device is employed and physiological monitoring is performed to confirm that the personal cooling devices are effective (using the monitoring guidance provided on page 8-21 in the NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Activities). Additional modification to the WBGT Index when personal cooling devices are employed when be evaluated on a case-by-case basis. Column 2 will be employed if permeable protective clothing (regardless of respiratory protection) is utilized. Permeable protective clothing includes cotton and Kleenguard™ coveralls. Column 3 will be employed if semi-permeable protective clothing (Tyvek) is utilized. Column 4 will be employed if impermeable protective clothing (Saranex) is utilized.

Please distribute this guidance to all personnel that have operations affected by heat stress considerations. Please do not hesitate to call if you have questions or comments.

RJC clh

Attachment
As Stated

Distribution

R E Bates
G W Beers
R J Carr
M E Findley
K D Jenkins
O McAfee
R A McCafferty
A W Medina
T T Sangaline
M D Schrenkengast
T N Timmons

cc

G Aguero
C A Benson
C Boardman
J Chapin
J A Cuicci
C S Evans
R C Fitz
T D Gray
L F Johnson
J E Law
D E Steffen
M R Wagner
M Wheeler
ESH&Q File
RMRS Records Center

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RFETS HEAT STRESS PROGRAM

HEAT STRESS GUIDELINES FOR LIGHT WORK

(1)		(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F	WBGT°F
Continuous	86	76	72	68
75/25%	87	77	73	69
50/50%	89	78 5	74 5	70 5
25/75%	90	79 9	75 9	71 9

HEAT STRESS GUIDELINES FOR MODERATE WORK

(1)		(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F	WBGT°F
Continuous	80	70	66	62
75/25%	82	72 4	68 4	64 4
50/50%	85	74 9	70 9	66 9
25/75%	88	77 9	73 9	69 9

HEAT STRESS GUIDELINES FOR HEAVY WORK

(1)		(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F	WBGT°F
Continuous	77	67	63	59
75/25%	78	68 6	64 6	60 6
50/50%	82	72 2	68 2	64 2
25/75%	86	76	72	68

(1) No Personal Protective Equipment

(2) One pair coveralls (Anti C), modesty garments, gloves, hood, shoe covers (Level D Haz Mat PPE)

(3) Two pair coveralls (Anti C), modesty garments, gloves, hood, shoe covers
or

One pair coveralls (Anti C), modesty garments, gloves, hood, respirator (Level C Haz Mat PPE)

(4) Two pair coveralls (Anti C), modesty garments, gloves, hood, shoe covers, respirator (Level A&B Haz Mat PPE)

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Threshold Limit Values/Warm-up Schedule for Four Hour Shift^{1,2}

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind													
°C (approx)	°F (approx)	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks												
-26° to -28°	-15° to -19°	(Norm Breaks) 1	1	(Norm Breaks) 1	1	75 min	2	55 min	3	40 min	4												
-29° to -31°	-20° to -24°	(Norm Breaks) 1	1	75min	2	55 min	3	40 min	4	30 min	5												
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non emergency work should cease													
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non emergency work should cease															
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non emergency work should cease																	
-40° to -42°	-40° to -44°	30 min	5	Non emergency work should cease																			
-43° & below	-45° & below	Non emergency work should cease																					

1. Schedule applies to any 4 hour work period with moderate to heavy work activity with warm up periods of ten (10) minutes in a warm location and with an extended break (e.g. lunch) at the end of the 4 hour work period in a warm location. For Light to Moderate Work (limited physical movement) apply the schedule one step lower. For example at -35°C (-30°F) with no noticeable wind (Step 4) a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4 hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available
5 mph light flag moves 10 mph light flag fully extended 15 mph raises newspaper sheet 20 mph blowing and drifting snow
3. If only the wind chill cooling rate is available a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be 1) special warm up breaks should be initiated at a wind chill cooling rate of about 1750 W/m² 2) all non emergency work should have ceased at or before a wind chill of 2250 W/m². In general the warmup schedule provided above slightly under compensates for the wind at the warmer temperatures assuming acclimatization and clothing appropriate for winter work. On the other hand the chart slightly over compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

Windchill Index

Wind Speed in mph	ACTUAL THERMOMETER READING (F)										
	50	40	30	20	10	0	-10	-20	-30	-40	-50
	EQUIVALENT TEMPERATURE (F)										
calm	50	40	30	20	10	0	-10	20	30	40	
5	48	37	27	16	6	5	15	26	36	47	
10	40	28	16	4	9	21	-33	-46	58	70	
15	36	22	9	5	18	36	45	58	72	85	
20	32	18	4	10	25	39	53	67	82	96	
25	30	16	0	15	29	44	59	74	88	104	
30	28	13	2	18	33	48	63	79	94	109	
35	27	11	4	20	35	-49	-67	82	98	113	
40	26	10	6	21	37	53	-69	85	-100	116	
Over 40 mph (little added effect)	LITTLE DANGER (for properly clothed person)			INCREASING DANGER (Danger from freezing of exposed flesh)				GREAT DANGER			

APPENDIX B

MATERIAL SAFETY DATA SHEETS

Household Chlorine Bleach

Hydraulic Fluid

Liquinox®

Motor Oil

Unleaded Gasoline

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The Clorox Company
7200 Johnson Drive
Pleasanton, California 94566
Tel (415) 847-6100

REC'D OCT 12 1987

Material Safety Data Sheet

CLOROX-HMIS	
HEALTH	2*
FLAMMABILITY	0
REACTIVITY	1
Personal Protection	B

I Chemical Identification								
NAME: REGULAR CLOROX BLEACH		CAS no. N/A						
DESCRIPTION: CLEAR, LIGHT YELLOW LIQUID WITH CHLORINE ODOR		RTECS no. N/A						
Other Designations Manufacturer Emergency Procedure								
EPA Reg. No. 5813-1 Sodium hypochlorite solution Liquid chlorine bleach Clorox Liquid Bleach	The Clorox Company 1221 Broadway Oakland, CA 94612	Notify your Supervisor Call your local poison control center or Rocky Mountain Poison Center (303) 573-1014						
II Health Hazard Data		III Hazardous Ingredients						
<p>*Causes severe but temporary eye injury. May irritate skin. May cause nausea and vomiting if ingested. Exposure to vapor or mist may irritate nose, throat and lungs. The following medical conditions may be aggravated by exposure to high concentrations of vapor or mist: heart conditions or chronic respiratory problems such as asthma, chronic bronchitis or obstructive lung disease. Under normal consumer use conditions the likelihood of any adverse health effects are low. FIRST AID EYE CONTACT: Immediately flush eyes with plenty of water. If irritation persists, see a doctor. SKIN CONTACT: Remove contaminated clothing. Wash area with water. INGESTION: Drink a glassful of water and call a physician. INHALATION: If breathing problems develop remove to fresh air.</p>		<table border="1"><thead><tr><th>Ingredients</th><th>Concentration</th><th>Worker Exposure Limit</th></tr></thead><tbody><tr><td>Sodium hypochlorite CAS# 7681-52-9</td><td>5.25%</td><td>not established</td></tr></tbody></table> <p>None of the ingredients in this product are on the IARC NTP or OSHA carcinogen list. Occasional clinical reports suggest a low potential for sensitization upon exaggerated exposure to sodium hypochlorite if skin damage (eg irritation) occurs during exposure. Routine clinical tests conducted on intact skin with Clorox Liquid Bleach found no sensitization in the test subjects.</p>	Ingredients	Concentration	Worker Exposure Limit	Sodium hypochlorite CAS# 7681-52-9	5.25%	not established
Ingredients	Concentration	Worker Exposure Limit						
Sodium hypochlorite CAS# 7681-52-9	5.25%	not established						
IV Special Protection Information		V Special Precautions						
<p>Hygienic Practices: Wear safety glasses. With repeated or prolonged use, wear gloves.</p> <p>Engineering Controls: Use general ventilation to minimize exposure to vapor or mist.</p> <p>Work Practices: Avoid eye and skin contact and inhalation of vapor or mist.</p>		<p>Keep out of reach of children. Do not get in eyes or on skin. Wash thoroughly with soap and water after handling. Do not mix with other household chemicals such as toilet bowl cleaners, rust removers, vinegar, acid or ammonia containing products. Store in a cool dry place. Do not reuse empty container. Rinse container and put in trash container.</p>						
VI Spill or Leak Procedures		VII Reactivity Data						
<p>Small quantities of less than 5 gallons may be flushed down drain. For larger quantities wipe up with an absorbent material or mop and dispose of in accordance with local, state and federal regulations. Dilute with water to minimize oxidizing effect on spilled surface.</p>		<p>Stable under normal use and storage conditions. Strong oxidizing agent. Reacts with other household chemicals such as toilet bowl cleaners, rust removers, vinegar, acids or ammonia containing products to produce hazardous gases such as chlorine and other chlorinated species. Prolonged contact with metal may cause pitting or discoloration.</p>						
VIII Fire and Explosion Data		IX Physical Data						
<p>Not flammable or explosive. In a fire, cool containers to prevent rupture and release of sodium chlorate.</p>		<p>Boiling point-----212°F/100°C (decompose) Specific Gravity (H₂O=1)-----1.085 Solubility in Water-----complete pH-----11.4</p>						

ELEMENTS (ICP)

M W Table 1

METHOD 7300
ISSUED 2/15/84

OSHA/NIOSH/ACGIH Table 1

PROPERTIES Table 1

ELEMENTS	aluminum	cobalt	manganese	silver	tungsten
	arsenic	copper	molybdenum	sodium	vanadium
	beryllium	iron	nickel	tellurium	yttrium
	cadmium	lead	phosphorus	thallium	zinc
	calcium	lithium	platinum	tin	zirconium
	chromium	magnesium	selenium	titanium	

SYNONYMS vary depending upon the compound

SAMPLING	MEASUREMENT
SAMPLER FILTER (0.8-µm, cellulose ester membrane)	TECHNIQUE INDUCTIVELY COUPLED ARGON PLASMA, ATOMIC EMISSION SPECTROSCOPY
FLOW RATE 1 to 4 L/min	ANALYTE elements above
VOL-MIN Table 1 -MAX Table 1	ASHING REAGENTS conc HNO ₃ , 4 mL, and conc HClO ₄ , 1 mL CONDITIONS room temperature, 30 min, 150 °C to near dryness
SHIPMENT routine	FINAL SOLUTION 4% HNO ₃ , 1% HClO ₄ , 10 mL
SAMPLE STABILITY stable	WAVELENGTH depends upon element, Table 2
BLANKS 2 to 10 field blanks per set	BACKGROUND CORRECTION spectral wavelength shift
ACCURACY	CALIBRATION elements in 4% HNO ₃ , 1% HClO ₄
BIAS none identified	RANGE 2.5 to 1000 µg per sample [1]
OVERALL PRECISION (s _r) not evaluated	ESTIMATED LOD 1 µg per sample [1]
	PRECISION (s _r) Table 2

APPLICABILITY The working range of this method is 0.005 to 2.0 mg/m³ for each element in a 500-L air sample. This is simultaneous elemental analysis, not compound specific. Verify that the types of compounds in the samples are soluble with this ashing procedure.

INTERFERENCES Spectral interferences are the primary interferences encountered in ICP-AES analysis. These are minimized by judicious wavelength selection, interelement correction factors and background correction [1,2].

OTHER METHODS This method replaces P&CAM 351 [2] for trace elements. Atomic absorption spectroscopy (e.g., Methods 70XX) is an alternate analytical technique for many of these elements.

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REAGENTS

- 1 Nitric acid, conc
- 2 Perchloric acid, conc *
- 3 Ashing acid 4 l (v/v) HNO_3 HClO_4
Mix 4 volumes conc HNO_3 with
1 volume conc HClO_4
- 4 Calibration stock solutions,
1000 $\mu\text{g/mL}$ Commercially available,
or prepared per instrument
manufacturer's recommendation (see
step 12)
- 5 Dilution acid, 4% HNO_3 , 1% HClO_4
Add 50 mL ashing acid to 600 mL
water, dilute to 1 L
- 6 Argon
- 7 Distilled, deionized water

*See Special Precautions

EQUIPMENT

- 1 Sampler cellulose ester membrane filter,
0.8- μm pore size, 37-mm diameter, in cassette
filter holder
- 2 Personal sampling pump, 1 to 4 L/min, with
flexible connecting tubing
- 3 Inductively coupled plasma-atomic emission
spectrometer, equipped as specified by the
manufacturer for analysis of elements of interest
- 4 Regulator, two-stage, for argon
- 5 Beakers, Phillips, 125-mL, or Griffin, 50-mL, with
watchglass covers *
- 6 Volumetric flasks, 10- and 100- mL *
- 7 Assorted volumetric pipets as needed *
- 8 Hotplate, surface temperature 150 $^\circ\text{C}$

*Clean all glassware with conc nitric acid and
rinse thoroughly in distilled water before use

SPECIAL PRECAUTIONS Perform all perchloric acid digestions in a perchloric acid hood

SAMPLING

- 1 Calibrate each personal sampling pump with a representative sampler in line
- 2 Sample at an accurately known flow rate between 1 and 4 L/min for a total sample size of
200 to 2000 L (see Table 1) for TWA measurements Do not exceed a filter loading of
approximately 2 mg total dust

SAMPLE PREPARATION

- 3 Open the cassette filter holders and transfer the samples and blanks to clean beakers
- 4 Add 5 mL ashing acid Cover with a watchglass Let stand 30 min at room temperature
NOTE Start a reagent blank at this step
- 5 Heat on hotplate (120 $^\circ\text{C}$) until ca 0.5 mL remains
NOTE Some species of Li, Mn, Mo, Sn, W, and Zr will not be completely solubilized by this
procedure Alternative solubilization techniques for most of these elements can be
found elsewhere [2, 3, 4, 5, 6, 7]
- 6 Add 2 mL ashing acid and repeat step 5 Repeat this step until the solution is clear
- 7 Remove watchglass and rinse into the beaker with distilled water
- 8 Increase the temperature to 150 $^\circ\text{C}$ and take the sample to dryness
- 9 Dissolve the residue in 2 to 3 mL dilution acid
- 10 Transfer the solutions quantitatively to 10-mL volumetric flasks
- 11 Dilute to volume with dilution acid

CALIBRATION AND QUALITY CONTROL

- 12 Calibrate the spectrometer according to the manufacturers recommendations

NOTE Typically, an acid blank and 10 $\mu\text{g/mL}$ multielement working standards are used The
following multielement combinations are chemically compatible in 4% HNO_3 /1% HClO_4

- a Ag, Ca, Co, Mn, Pb, V, Zn,
- b Al, Be, Cd, La, Li, Ni, Ti,
- c As, B, Ba, Mg, Mo, P, Sn,

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- d Cu, Fe, Na, Pt, Sr, Te, Y,
- e Cr, K, Sb, Se, Ti, Zr, and
- f Si, W (distilled water only)

- 13 Analyze a standard for every ten samples
- 14 Check recoveries with at least two spiked media blanks per ten samples

MEASUREMENT

- 15 Set spectrometer to conditions specified by manufacturer
- 16 Analyze standards and samples
 - NOTE If the values for the samples are above the range of the standards, dilute the solutions with dilution acid, reanalyze and apply the appropriate dilution factor in the calculations

CALCULATIONS

- 17 Obtain the solution concentrations for the sample, C_s ($\mu\text{g/mL}$), and the average media blank, C_b ($\mu\text{g/mL}$), from the instrument
- 18 Using the solution volumes of sample, V_s (mL), and media blank, V_b (mL), calculate the concentration, C (mg/m^3), of each element in the air volume sampled, V (L)

$$C = \frac{C_s V_s - C_b V_b}{V}, \text{ mg/m}^3$$

EVALUATION OF METHOD

Method P&CAM 351 was evaluated in 1981 [1,2]. The precision and recovery data were determined at 2.5 and 1000 μg of each element per sample on spiked filters. The precision and recovery data, instrumental detection limits, sensitivity, and analytical wavelengths are listed in Table 2. The values in Table 2 were determined with a Jarrell-Ash Model 1160 ICP operated according to manufacturer's instructions.

REFERENCES

- [1] Hull, R. D. "Multielement Analysis of Industrial Hygiene Samples," NIOSH Internal Report, presented at the American Industrial Hygiene Conference, Portland, Oregon (May 1981)
- [2] NIOSH Manual of Analytical Methods, 2nd ed., V. 7, P&CAM 351, U.S. Department of Health and Human Services, Publ. (NIOSH) 82-100 (1981)
- [3] Ibid, S341 (Lead)
- [4] Ibid, V. 2, S5 (Manganese), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-B (1977)
- [5] Ibid, V. 4, P&CAM 271 (Tungsten), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-175 (1978)
- [6] Ibid, V. 5, P&CAM 173 (Metals by Atomic Absorption), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 79-141 (1979)
- [7] Ibid, V. 3, S183 (Tin), S185 (Zirconium), and S376 (Molybdenum), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977)

METHOD REVISED BY R. DeLon Hull and Mark Millson, NIOSH/DPSE

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Table 1 Properties and sampling volumes

Element (Symbol)	Properties		Permissible Exposure Limits, mg/m ³ TWA OSHA/NIOSH/ACGIH	Air Volume @ OSHA, L	
	Atomic Weight	MP, °C		MIN	MAX
Silver (Ag)	107 87	961	0 01/ -- / 0 1	250	2000
Aluminum (Al)	26 98	660	-- / -- / 10	5 (g)	100 (g)
Arsenic (As)	74 92	817*	0 5/C 0 002/ 0 2	5	2000
Beryllium (Be)	9 01	1278	0 002/ 0 0005/ 0 002	1250	2000
Calcium (Ca)	40 08	842	5 (b)/ -- / 2 (b)	5	200
Cadmium (Cd)	112 40	321	0 2/ 0 04/ 0 05	13	2000
Cobalt (Co)	58 93	1495	0 1/ -- / 0 1	25	2000
Chromium (Cr)	52 00	1890	1 0 (c)/ 0 025/ 0 5 (c)	5	1000
Copper (Cu)	63 54	1083	1 0/ -- / 1 0	5	1000
Iron (Fe)	55 85	1535	10 (b)/ -- / 5 (b)	5	100
Lithium (Li)	6 94	179	0 025 (d)/ -- / 0 025 (d)	100	2000
Magnesium (Mg)	24 31	651	15 (b)/ -- / 10 (b)	5	67
Manganese (Mn)	54 94	1244	C 5/ -- / C 5	5	200
Molybdenum (Mo)	95 94	651	15 (e)/ -- / 10 (e)	5	67
Sodium (Na)	22 99	98	2 (f)/ C 2 (f)/ C 2 (f)	13	2000
Nickel (Ni)	58 71	1453	1/ 0 015/ 1 (c)	5	1000
Phosphorus (P)	30 97	44	-- / -- / 0 1	25 (g)	2000 (g)
Lead (Pb)	207 19	328	0 05/ 0 1/ 0 15	50	2000
Platinum (Pt)	195 09	1769	0 002 (a)/ -- / 1 (c)	1250	2000
Selenium (Se)	78 96	217	0 2/ -- / --	13	2000
Tin (Sn)	118 69	232	2/ -- / 2 (c)	5	500
Tellurium (Te)	127 60	450	0 1/ -- / 0 1	25	2000
Titanium (Ti)	47 90	1675	-- / -- / 10 (b)	5	100
Thallium (Tl)	204 37	304	0 1 (a)/ -- / 0 1 (a)	25	2000
Vanadium (V)	50 94	1890	C 0 5/ 1 (c)/ 0 05 (V ₂ O ₅)	5	2000
Tungsten (W)	183 85	3410	-- / 5 (e)/ 5 (e)	5 (g)	200 (g)
Yttrium (Y)	88 91	1495	1/ -- / 1	5	1000
Zinc (Zn)	65 37	419	5 (b)/ 5 (b)/ 5 (b)	5	200
Zirconium (Zr)	91 22	1852	5/ -- / 5	5	200

(a) soluble

(b) oxide

(c) metal

(d) hydride

(e) insoluble

(f) hydroxide

(g) at the ACGIH TLV

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CITGO Petroleum Corporation
P. O. Box 3758
Tulsa, Oklahoma 74102

Material Safety Data Sheet

Generic Name CITGO Hydraulic Fluids SUS-2 Date February 20, 1997

Generic Code HF-002

THIS GENERIC MSDS REPRESENTS THE FOLLOWING CITGO PRODUCTS

<u>Trade Name</u>	<u>Commodity Code No.</u>
CITGO Pacemaker 32	33-001
CITGO Pacemaker 19	33-013
CITGO A/W Hydraulic Oil 22	33-410
CITGO A/W Hydraulic Oil 32	33-415
CITGO A/W 32 Dover	33-477
CITGO A/W-D Hydraulic Oil 32	33-481
CITGO Pacemaker T-32	33-715
CITGO A/W All Temperature Hydraulic Oil	33-932

Synonyms	Lubricating Oil	Technical Contact	(918) 495-5933
CAS No	Mixture (Refer to Section 1)	Medical Emergency	(918) 495-4700
CITGO Index No	1965	CHEMTREC Emergency	(800) 424-9300

MATERIAL HAZARD EVALUATION

(Per OSHA Hazard Communication Standard [29 CFR 1910.1200])

Health Precautions **WARNING** Oil injected into the skin from high pressure leaks in hydraulic systems can cause severe injury. Most damage occurs during the first few hours. Seek medical attention immediately. Surgical removal of oil may be necessary. Protect exposed skin from repeated or prolonged exposure.

Safety Precautions Do not store material in open or unmarked containers.

HMIS Rating¹ Health 0 Flammability 1 Reactivity 0

1.0 GENERIC COMPOSITION / COMPONENTS

Components	CAS No	%	Hazard Data
Refined Petroleum Oil(s)	Refer to Section 1.1	> 95	Oral LD ₅₀ (rat) > 5 g/kg Dermal and Eye Mild-irritant Inhalation LC ₅₀ /4H (rat) > 5 000 mg/M ³ Hazard data are based upon similar components

¹Hazard Rating: least-0, slight-1, moderate-2, high-3, extreme-4

CITGO assigned these values based upon an evaluation conducted pursuant to NTPA guidelines. Use of an asterisk (*) indicates that the material may present chronic health effects.

NA-Not Applicable

ND-No Data

NE-Not Established

CITGO Hydraulic Fluids, SUS-2 (HF-002, February 20, 1997, CIN 1965)

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1.0 GENERIC COMPOSITION / COMPONENTS (continued)

Components	CAS No	%	Hazard Data	
Anti-oxidant/Anti-wear Agent (may contain Zinc Dialkylthiophosphate)	Mixture	< 2	Oral Eye Dermal Inhalation	Potential aspiration hazard Mild to moderate irritant Mild to moderate irritant Potential respiratory tract irritant
VI Improver	Mixture	0 - 5	Oral LD ₅₀ (rat) Dermal LD ₅₀ (rabbit) Dermal Eye	> 5 g/kg > 2 g/kg Mild irritant. May be absorbed through the skin Potential irritant

2.0 PHYSICAL DATA

PHYSICAL HAZARD CLASSIFICATION (Per 29 CFR 1910.1200)

Combustible	No	Flammable	No	Pyrophoric	No
Compressed Gas	No	Organic Peroxide	No	Reactivity	No
Explosive	No	Oxidizer	No	Stable	Yes

Boiling Point, 760 mm Hg, °C (°F)	- 278 - 390 (~ 533 - 740)
Specific Gravity (60/60 °F) (H ₂ O = 1)	- 0.86 - 0.88
Vapor Density (Air = 1)	> 1
% Volatiles by Volume	Negligible
Melting Point, °C (°F)	NA
Vapor Pressure, mm Hg (25°C)	- 2x10 ⁻⁵ to 4x10 ⁻⁴
Solubility in Water	Negligible
Evaporation Rate (n-butyl acetate = 1)	< 1
pH of Undiluted Product	NA
Appearance and Odor	Light amber liquid mild petroleum odor

3.0 FIRE AND EXPLOSION DATA

Flash Point, OC, °C (°F)	185 - 236 (365 - 453)
Flash Point, CC, °C (°F)	ND
Autoignition Temperature, °C (°F)	ND
NFPA Rating ²	Health 0 Flammability 1 Reactivity 0
Flammable Limits (% by volume in air)	Lower ND Upper ND
Extinguishing Media	CO ₂ dry chemical, foam, water fog
Special Fire Fighting Procedure	None
Unusual Fire or Explosion Hazard	Water may cause frothing Material may be ignited by sparks or flames

Hazard Rating least-0, slight-1, moderate-2, high-3, extreme-4

CITGO assigned these values based upon an evaluation conducted pursuant to NFPA guidelines

NA-Not Applicable

ND-No Data

NE-Not Established

CITGO Hydraulic Fluids SUS-2 (HF-002, February 20 1997 CIN 1965)

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4.0 REACTIVITY DATA

Stability	Stable
Conditions Contributing to Instability	None
Incompatibility	This material may react with strong oxidants, acids and caustics
Hazardous Decomposition Products (thermal unless otherwise specified)	CO ₂ (CO with incomplete combustion), and possible trace oxides of nitrogen phosphorus, sulfur and zinc
Hazardous Polymerization	Hazardous polymerization is not expected to occur

5.0 SPILL, LEAK AND DISPOSAL PROCEDURES

Procedure if Material is Spilled

- Remove all ignition sources
- Isolate the area of the spill and restrict access to persons wearing protective clothing
- Ventilate area of release, as necessary, to disperse vapors and mists
- **Small Spills** Absorb released material with non-combustible absorbent. Place into containers for later disposal. (See Waste Disposal section below)
- **Large Spills** Evacuate area in the event of significant spills. Evaluate exposure potential. Potential exposure may require the use of respiratory protection. Use protective clothing. Contain spill in temporary dikes to avoid product migration and to assist in recovery. Do not allow material to escape into sewers, ground water, drainage ditches or surface waters.
- Administer appropriate first aid
- Report releases as required to the appropriate federal, state and local authorities

Waste Disposal

- It is the responsibility of the user to determine if the material is a hazardous waste at the time of disposal
- Determine compliance status with all applicable requirements prior to disposal
- Contact the RCRA/Superfund Hotline at (800) 424-9346 or your regional US EPA office for guidance concerning case specific disposal issues

Protective Measures During Repair and Maintenance of Contaminated Equipment

- Refer to Section 7.0 - Special Protection Information
- Drain and purge equipment, as necessary, to remove material residues
- Use gloves constructed of impervious materials such as heavy nitrile rubber and protective work clothing if direct contact is anticipated
- Eliminate heat and ignition sources
- Do not allow oil to be injected into the skin from high pressure leaks in hydraulic systems
- Wash exposed skin thoroughly with soap and water
- Remove contaminated clothing. Launder before reuse
- Keep unnecessary persons from hazard area

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6 0 HEALTH HAZARD DATA

Health Hazard Classification (Per 29 CFR 1910.1200)

Highly Toxic	No	Sensitizer	No
Toxic	No	Reproductive Effects	No
Corrosive	No	Mutagen	No
Irritant	No	Target Organ	No

Carcinogen

Product/Component	CAS No	Conc (%)	NTP	IARC	OSHA	Other
CITGO Hydraulic Fluids SUS-2	Mixture	100	No	No	No	No

Toxicity Summary Generally of a low order of toxicity

Major Route of Entry Inhalation of incidental mists or vapors, skin contact with liquid

Acute Exposure Symptoms

Inhalation In enclosed spaces or at elevated temperatures, vapors may reach concentrations sufficient to cause drowsiness, dizziness, headache, nausea, or lung irritation. Elevated mist concentrations above applicable workplace exposure levels may cause lung damage.

Dermal Contact Mild irritant.

Eye Contact Mild irritation may result from elevated mist concentrations or direct contact with splashing liquid.

Ingestion The Saybolt viscosity of the materials represented by this MSDS range from 100 to 199 SUS at 100° F. Accordingly, there is a risk of aspirating this material into the lungs when swallowed. Aspiration may result in severe lung damage. Upon ingestion of large quantities, gastrointestinal discomfort, diarrhea, and headache may occur. Small doses may produce irritation, and diarrhea.

Injection Injection under the skin, in muscle or into the bloodstream may result in irritation, erythema, edema or severe, permanent tissue damage. Most damage occurs during the first few hours.

Chronic Exposure Symptoms

Prolonged and/or frequent contact may cause drying, cracking (dermatitis) or folliculitis.

Other Special Effects

None expected.

Medical Conditions Aggravated by Exposure

None.

First Aid and Emergency Procedures for Acute Effects

Inhalation Move victim to fresh air. If victim is not breathing, immediately begin cardiopulmonary resuscitation (CPR). If breathing is difficult, 100 percent humidified oxygen should be administered by a qualified individual. Seek medical attention immediately.

Dermal Wash exposed skin with soap and water. Remove contaminated clothing. Launder before use. Seek medical attention if irritation or pain persists.

NA-Not Applicable

ND-No Data

NE-Not Established

CITGO Hydraulic Fluids, SUS-2 (HF-002, February 20, 1997, CIN 1965)

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6 0 HEALTH HAZARD DATA (continued)

- Eyes** Flush eyes with large volumes of water. Seek medical attention if irritation, pain or excessive tearing persists.
- Ingestion** Do not induce vomiting. If spontaneous vomiting is about to occur, place victim's head below knees. Seek medical attention immediately.
- Injection** Injection under the skin, in muscle or into the blood stream is a medical emergency. Seek medical attention immediately.

Notes to Physician

The Saybolt viscosity of the products represented by this MSDS range between 100 to 199 SUS at 100° F. Upon ingestion, there is a risk of aspiration into the lungs. Aspiration may result in chemical pneumonitis. Removal by careful gastric lavage may be considered. Subcutaneous or intramuscular injection requires prompt surgical debridement.

7 0 SPECIAL PROTECTION INFORMATION

Ventilation Requirements

Use in well ventilated area. In confined space, mechanical ventilation may be required to keep levels of certain components below applicable workplace exposure levels as evaluated by designated and properly trained personnel.

Applicable Workplace Exposure Levels

Chemical Component	ACGIH TLV TWA ppm (mg/M ³)	ACGIH TLV STEL/Ceiling (C) ppm (mg/M ³)	ACGIH TLV Skin notation?	OSHA PEL TWA ppm (mg/M ³)	OSHA PEL STEL/Ceiling (C) ppm (mg/M ³)	OSHA PEL Skin notation?
Oil Mist Mineral	(5)	(10)	No	(5)	NE	No

Specific Personal Protective Equipment

Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations.

- Respirator** At elevated temperatures, vapor or mist concentrations may exceed applicable workplace exposure levels. Use a NIOSH or MSHA approved organic vapor/mist chemical cartridge respirator when elevated airborne concentrations are anticipated.
- Eyes** Safety glasses or chemical splash goggles if splashing is anticipated.
- Dermal** Oil impervious gloves if frequent or prolonged contact is expected.
- Other Clothing or Equipment** Wear body-covering work clothes to avoid prolonged or repeated exposure. Launder contaminated work clothes before reuse.

8 0 TRANSPORTATION AND SPECIAL PRECAUTIONS

- Storage** Store below 150° F. Do not apply heat or flame to container. Keep separate from strong oxidizing agents.

NA-Not Applicable

ND-No Data

NE-Not Established

CITGO Hydraulic Fluids SUS-2 (HF-002 February 20, 1997 CN 1965)

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8 0 TRANSPORTATION AND SPECIAL PRECAUTIONS (continued)

Caution Empty containers may contain combustible product residues. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers and/or waste residues of this product.

DOT Information

Proper Shipping Name	Petroleum Lubricating Oil
Hazard Class	Non hazardous
Hazard Identification No	None Assigned
Packaging Group	None Assigned
Placard	None
Compatibility Category	Group 33
CHRIS Code	OLB

9 0 ENVIRONMENTAL DATA

Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA)

Section 313 - Toxic Chemicals

This product is not known to contain any components in concentrations above *de minimis* levels that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA.

Section 311/312 - Hazard Categories

This product may meet one or more of the criteria for the hazard categories defined in 40 CFR Part 370 as established by Sections 311 and 312 of SARA as indicated below.

Immediate (Acute) Health Hazard	<u>No</u>	Sudden Release of Pressure Hazard	<u>No</u>
Delayed (Chronic) Health Hazard	<u>No</u>	Reactive Hazard	<u>No</u>
Fire Hazard	<u>No</u>		

Section 302 - Extremely Hazardous Substances

This product is not known to contain any components in concentrations greater than one percent that are listed as Extremely Hazardous Substances in 40 CFR Part 355 pursuant to the requirements of Section 302(a) of SARA.

Clean Water Act (CWA)

Under the CWA, discharges of crude oil and petroleum products to surface water without proper Federal and State permits must be reported immediately to the National Response Center at (800) 424-8802.

Comprehensive Environmental Response, Compensation & Liability Act (CERCLA) Section 102 Hazardous Substances

As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance.

California Proposition 65 (The Safe Drinking Water and Toxics Enforcement Act)

This material contains components that are known to the State of California to be

Carcinogenic	<u>No</u>	Reproductive Hazard	<u>No</u>
--------------	-----------	---------------------	-----------

Toxic Substances Control Act (TSCA)

Reported in TSCA Inventory as	Product	Components
CITGO Hydraulic Fluids SUS-2		X

NA-Not Applicable

ND-No Data

NE-Not Established

CITGO Hydraulic Fluids, SUS-2 (HF-002, February 20, 1997, CIN 1965)

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100 LABELING

WARNING Oil injected into the skin from high pressure leaks in hydraulic systems can cause severe injury. Most damage occurs during the first few hours. Seek medical attention immediately. Surgical removal of oil may be necessary.

110 REFINED PETROLEUM OILS

The products listed on page one of this MSDS contains one or more of the following base oils

<u>Chemical / Common Name</u>	<u>CAS No.</u>
Solvent Refined Heavy Paraffinic Distillate	64741-88-4
Solvent Refined Light Paraffinic Distillate	64741-89-5
Solvent Dewaxed Heavy Paraffinic Distillate	64742-65-0
Hydrotreated Light Paraffinic Distillate	64742-55-8
Hydrotreated Heavy Paraffinic Distillate	64742-54-7
Hydrotreated Heavy Naphthenic Distillate	64742-52-5
Hydrotreated Neutral Oils	72623-87-1

ALL STATEMENTS, INFORMATION, AND DATA PROVIDED IN THIS MATERIAL SAFETY DATA SHEET ARE BELIEVED TO BE ACCURATE AND RELIABLE, BUT ARE PRESENTED WITHOUT GUARANTEE, REPRESENTATION, WARRANTY, OR RESPONSIBILITY OF ANY KIND, EXPRESSED OR IMPLIED. ANY AND ALL REPRESENTATIONS AND/OR WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE SPECIFICALLY DISCLAIMED. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION OR PRODUCTS FOR THEIR PARTICULAR PURPOSE. NOTHING CONTAINED HEREIN IS INTENDED AS PERMISSION, INDUCEMENT OR RECOMMENDATION TO VIOLATE ANY LAWS OR TO PRACTICE ANY INVENTION COVERED BY EXISTING PATENTS, COPYRIGHTS OR INVENTIONS.

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MATERIAL SAFETY DATA SHEET

LIQUI-NOX™

Manufactured by:
ALCONOX, INC.
9 EAST 140TH STREET
NEW YORK, NY 10016

TELEPHONE NUMBER FOR EMERGENCY: CHEM-TEL 1-800-255-3924
TELEPHONE NUMBER FOR INFORMATION: (212) 532-4040

SECTION I. IDENTIFICATION

Product Name (As appears on Label):	LIQUI-NOX™
CAS Registry Number:	NOT APPLICABLE
Date Prepared:-	JULY 29, 1993
Chemical Family:	ANIONIC LIQUID DETERGENT

SECTION II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

THERE ARE NO HAZARDOUS INGREDIENTS IN LIQUI-NOX AS DEFINED BY THE OSHA STANDARD 29 CFR 1910 SUBPART Z, THE HAZARDOUS SUBSTANCE LIST

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point:	214°F
Vapor Pressure (mm Hg):	NO DATA
Vapor Density (AIR =1):	NO DATA
Specific Gravity (Water=1):	1.075
Melting Point:	NOT APPLICABLE
Evaporation Rate (Butyl Acetate = 1):	SLOWER
Solubility in Water:	COMPLETELY SOLUBLE IN ALL PROPORTIONS
Appearance	YELLOW LIQUID, NEARLY ODORLESS

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point:	NONE (CLEVELAND OPEN CUP)
Flammable Limits:	NOT APPLICABLE
Ext. Quenching Media:	LEL: NO DATA UEL: NO DATA WATER, DRY CHEMICALS, CO ₂ , FOAM
Special Firefighting Procedures:	SELF-CONTAINED POSITIVE PRESSURE BREATHING APPARATUS AND PROTECTIVE CLOTHING SHOULD BE WORN FIGHTING FIRES INVOLVING CHEMICALS
Unusual Fire and Explosion Hazards	NONE

National Fire Protection Association 704 Labeling:

Degree of Hazard 0 = (insignificant), 1 = slight, 2 = moderate, 3 = high, 4 = extreme

RED (FIRE):	0
BLUE (HEALTH):	0
YELLOW (REACTIVITY):	0
WHITE (SPECIAL):	0

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11001-MUX MSDS

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SECTION VI: REACTIVITY DATA

Stability:

Conditions to Avoid:

Incompatibility (Materials to Avoid):

Hazardous Decomposition or Byproducts:

STABLE

NONE

OXIDIZING OR ALKALINE SOLUTIONS

MAY RELEASE SO₂ ON BURNING**SECTION VII: HEALTH HAZARD DATA**

Routes of Entry: Inhalation?: NO

Health Hazards (Acute and Chronic):

Skin: YES

Ingestion: YES

SKIN CONTACT MAY PROVE LOCALLY

IRRITATING, CAUSING DRYING AND/OR

CHAPPING. INGESTION MAY CAUSE

DISCOMFORT AND/OR DIARRHEA.

Carcinogenicity. NTP?: NO

IARC Monographs?: NO

OSHA Regulated? NO

Signs and Symptoms of Exposure:

PROLONGED SKIN CONTACT MAY CAUSE DRYING
AND/OR CHAPPING.

Medical Conditions Generally

Aggravated by Exposure:

NOT ESTABLISHED. UNNECESSARY EXPOSURE
TO THIS PRODUCT OR ANY INDUSTRIAL
CHEMICAL SHOULD BE AVOIDED.

Emergency and First Aid

Procedures

Eyes - IMMEDIATELY FLUSH WITH WATER FOR AT LEAST 15 MINUTES

Skin - FLUSH WITH PLENTY OF WATER

Ingestion - DRINK LARGE QUANTITIES OF WATER OR MILK.

SEE A PHYSICIAN FOR DISCOMFORT.

SECTION VIII: PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material

Is Released or Spilled:

MATERIAL FOAMS PROFUSELY. FOR SMALL
SPILLS RECOVER AS MUCH AS POSSIBLE WITH
ABSORBENT MATERIAL AND FLUSH REMAINDER
TO SEWER. MATERIAL IS BIODEGRADABLE

Waste Disposal Method

SMALL QUANTITIES MAY BE DISPOSED OF IN
SEWER. LARGE QUANTITIES SHOULD BE
DISPOSED OF IN ACCORDANCE WITH LOCAL
ORDNANCES FOR DETERGENT PRODUCTSPrecautions to be Taken in
Storing and HandlingNO SPECIAL PRECAUTIONS IN STORING USE
PROTECTIVE EQUIPMENT WHEN HANDLING
UNDILUTE MATERIAL

Other Precautions

NO SPECIAL REQUIREMENTS OTHER THAN GOOD
INDUSTRIAL HYGIENE AND SAFETY PRACTICES
EMPLOYED WITH ANY INDUSTRIAL CHEMICAL**VIII CONTROL MEASURES**

Respiratory Protection (Specify Type):

Ventilation - Local Exhaust:

- Special:

- Mechanical

- Other:

NOT REQUIRED

NORMAL

NOT REQUIRED

NOT REQUIRED

NOT REQUIRED

Protective Gloves:

Eye protection:

IMPERVIOUS GLOVES ARE RECOMMENDED

GOGGLES AND/OR SPLASH SHIELDS ARE

RECOMMENDED.

Other Protective Clothing or

Equipment

Work/Hygienic Practices:

NOT REQUIRED

NO SPECIAL PRACTICES REQUIRED

ALL INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED

ON 004108400 01/01/96/MSD/73

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REC'D NOV 17 1986

INDUSTRIAL HYGIENE, TOXICOLOGY, AND MATERIAL
SAFETY DATA SHEET



NOTE NO REPRESENTATION IS MADE AS TO THE ACCURACY OF THE INFORMATION
HEREIN. SEE PAGE 7 FOR CONDITIONS UNDER WHICH DATA ARE FURNISHED

Trade Name and Synonyms	
01691 DIESEL ENGINE OIL 13	
Manufacturer's Name	Emergency Telephone No
Texaco Inc	(914) 831-3400 ext 204
Address	
P.O. Box 509 Beacon, NY 12508	
Chemical Name and/or Family or Description	
Diesel Engine Oil	
THIS PRODUCT IS CLASSIFIED AS <u> X </u> NOT HAZARDOUS	
<u> </u> HAZARDOUS BY DEFINITION NO(S) <u> </u> ON ATTACHED EXPLANATION SHEETS	
WARNING STATEMENT	
WARNING! AVOID SKIN CONTACT WITH USED MOTOR OILS	
OCCUPATIONAL CONTROL PROCEDURES	
Protective Equipment (Type)	
Eyes	Chemical type goggles or face shield optional
Skin	Exposed employees should exercise reasonable personal cleanliness, this includes cleansing exposed skin areas several times daily with soap and water, and laundering or dry cleaning soiled work clothing at least weekly
Inhalation	None required if exposures are within permissible concentrations, see below.
Ventilation	Adequate to meet permissible concentrations
Permissible Concentrations.	
Air	5 mg/cubic meter of air for mineral oil mist averaged over an 8 hour daily exposure (ACGIH 1984-85)
EMERGENCY AND FIRST AID PROCEDURES	
First Aid	
Eyes	As with most foreign materials, should eye contact occur, flush eyes with plenty of water
Skin	None considered necessary
Ingestion	None considered necessary
Inhalation	None considered necessary
Other Instructions.	None.

ND - Not Determined NA - Not Applicable
< - Less Than > - Greater Than

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**PHYSIOLOGICAL EFFECTS:**

Code

No.

01691

Effects of Exposure**Acute**

Eyes

Believed to be minimally irritating

Skin

Believed to be minimally irritating

Respiratory System

Believed to be minimally irritating if not in excess of permissible concentrations, see page 1

Chronic

N.D

Other

-

Sensitization PropertiesSkin: Yes ☐ No ☐ Unknown ☒Respiratory: Yes ☐ No ☐ Unknown ☒**Median Lethal Dose (LD₅₀ LC₅₀ XSpecies)**Oral Believed to be > 5 g/kg (rat), practically non-toxicInhalation N.D.Dermal Believed to be > 3 g/kg (rabbit); practically non-toxicOther N. D.**Irritation Index Estimation of Irritation (Species)**Skin Believed to be < 0.5/80 (rabbit); no appreciable effectEyes Believed to be < 15/110 (rabbit), no appreciable effectSymptoms of Exposure None expected other than possible minimal irritation**FIRE PROTECTION INFORMATION**Ignition Temp °F N.D.

Flash Point °F (Method)

490° F COCFlammable Limits (%) Lower N.D.Upper N D**Products Evolved When Subjected to Heat or Combustion**

Carbon monoxide and carbon dioxide may be formed on burning in limited air supply.

Recommended Fire Extinguishing Agents And Special Procedures

According to the National Fire Protection Association Guide, use water spray, dry chemical, foam, or carbon dioxide. Water or foam may cause frothing. Use water to cool fire-exposed containers. If a leak or spill has not ignited, use water spray to disperse the vapors and to provide protection for persons attempting to stop the leak.

Unusual or Explosive Hazards.

None.

ND - Not Determined
< - Less Than

N.A. - Not Applicable
> - Greater Than



ENVIRONMENTAL PROTECTION		Code No.
		01691
Waste Disposal Method: Under RCRA, it is the responsibility of the user of products to determine, at the time of disposal, whether product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixture, processes, etc. may render the resulting material hazardous (See Remarks for Waste Classification).		
Procedures in Case of Breakage or Leakage: (Transportation Spills Call CHEMTREC (800) 424-9300) Contain spill if possible. Wipe up or absorb on suitable material and shovel up.		
Remarks: Waste Classification: Product has been evaluated for RCRA characteristics and does not meet criteria of a hazardous waste if discarded in its purchased form.		
PRECAUTIONS:		
<p>WARNING: AVOID SKIN CONTACT WITH USED MOTOR OILS</p> <p>Used gasoline motor oils have caused skin cancer in laboratory animals when repeatedly applied and left in place between applications. In case of skin contact, promptly wash thoroughly with soap and water. Oil-soiled clothing should be cleaned before reuse.</p>		
Requirements for Transportation, Handling and Storage: Minimum feasible handling temperatures should be maintained. Periods of exposure to high temperatures should be minimized. Water contamination should be avoided.		
DOT Proper Shipping Name: N.A. DOT Hazard Class (if applicable): N.A.		
CHEMICAL AND PHYSICAL PROPERTIES		
Boiling Point (°F) <u>High</u> Vapor Pressure <u>Low</u> (mmHg)		
Specific Gravity <u>0.9129</u> (H ₂ O=1) Vapor Density <u>N D</u> (Air=1)		
Appearance and Odor <u>Dark pale liquid</u>		
pH of undiluted product <u>N A.</u> Solubility <u>Neglig</u>		
Percent Volatile by Volume <u>Nil</u> Evaporation <u>N D</u> ()=1		
Viscosity <u>198.3 cSt @ 40°C</u> Other <u>-</u>		
Hazardous Polymerizations <u>-</u> Occur <u>X</u> Do not occur		
The Material Reacts Violently With (if others is checked below, see additional comments on page 6 for further details)		
Air	Water	Heat
		Strong Oxidizers
		Others
		None of These
		X

ND - Not Determined
< - Less Than

NA - Not Applicable
> - Greater Than

**COMPOSITION**Code
No.

01691

Chemical/Common Name	CAS No	Exposure Limit	Range in %
*Adtv Pkg containing calcium phenolate, alkenyl succinimide			11 00 - 19 99
Solvent-dewaxed heavy paraffinic petroleum distillates	64742650	5 0 mg/m3 TWA	35 00 - 49 99
Severely solvent-refined hydrotreated heavy naphthenic petroleum distillates	64742525	5 0 mg/m3 TWA- ACGIH	35 00 - 49 99

*Hazardous according to OSHA (1910.1200) or one or more state Right-To-Know lists



PRODUCT SHIPPING LABEL

Code
No.

01691

01691 DIESEL ENGINE OIL 13

WARNING! AVOID SKIN CONTACT WITH USED MOTOR OILS

Used gasoline motor oils have caused skin cancer in laboratory animals when repeatedly applied and left in place between applications.

In case of skin contact, promptly wash thoroughly with soap and water.

Oil-soiled clothing should be cleaned before reuse

Chemical/Common Name	CAS No	Range in %
•Adtv. Pkg. containing calcium phenolate, alkenyl succinimide		11 00 - 19 99
Solvent-dewaxed heavy paraffinic petroleum distillates	64742650	35 00 - 49 99
Severely solvent-refined hydrotreated heavy naphthenic petroleum distillates	64742525	35 00 - 49 99

•Hazardous according to OSHA (1910.1200) or one or more state Right-To-Know lists

	Health	HMIS 0	Reactivity	0
	Flammability. 1		Special	-

CAUTION: Misuse of empty containers can be hazardous. Empty containers can be hazardous if used to store toxic flammable or reactive materials. Cutting or welding of empty containers might cause fire explosion or toxic fumes from residues. Do not pressurize or expose to open flame or heat. Keep container closed and drum bungs in place.

HEALTH EMERGENCY TELEPHONE (914) 831-3400 (EXT 204)

Texaco Inc.
2000 Westchester Avenue
White Plains, New York 10650

For Additional Information Concerning:

Fuels/Lubricants/Antifreezes
call (914) 831-3400 (EXT 204)
Chemicals/Additives
call (408) 722-8381
Transportation Spills
call CHEMTREC (800) 424-9300

**ADDITIONAL COMMENTS**Code
No.

01691

TEXACO INTENDS TO COMPLY FULLY WITH PROVISIONS OF THE TOXIC SUBSTANCES CONTROL ACT
STATE OF MICHIGAN CRITICAL MATERIALS ACT (REVISED 1985)

To determine applicability or effect of any law or regulation with respect to the product, users should consult his
legal advisor or the appropriate government agency. Texaco does not undertake to furnish advice on such matters.

By R. T. Richards Title Mgr Env Conservation & Toxicology
Date 01-10-86 ☐ New ☒ Revised Supersedes 11-06-85

ND - Not Determined
< - Less Than

N.A. - Not Applicable
> - Greater Than

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USA and WORLDWIDE

September 29 1995

Material Safety Data Sheet

UNLEADED REGULAR GASOLINE (Including Reformulated)

PHILLIPS 66 COMPANY		PHONE NUMBERS	
A Division of Phillips Petroleum Company		Emergency	(918) 661-8118
Bartlesville, Oklahoma 74004		General MSDS Information	(918) 661-3709
		For Additional MSDSs	(918) 661-3709

A. Product Identification

Synonyms	Motor Fuel Petrol
Chemical Name	Mixture
Chemical Family	Hydrocarbon
Chemical Formula	Mixture
CAS Reg No	Mixture
Product No	12050, 12051, 12750, 12751, 12080, 12081, 11050, 11051, 12180, 12181, 12170, 12171, 12280, 12281, 12270, 12271, 12380, 12381, 12370, 12371

Product and/or Components Entered on EPA's TSCA Inventory YES

This product is in U S commerce and is listed in the Toxic Substances Control Act (TSCA) Inventory of Chemicals, hence, it may be subject to applicable TSCA provisions and restrictions

B. Components

Ingredients	CAS Number	/ By Wt	OSHA PEL	ACGIH TLV
Gasoline, including	8006-61-9	100	300 ppm	300 ppm
Benzene	71-43-2	<5	10 ppm (1)	10 ppm
Toluene	108-88-3	1-35	100 ppm	50 ppm
Ethyl Benzene	100-41-4	0-4	100 ppm	100 ppm
Xylenes (mixed isomers)	1330-20-7	1-10	100 ppm	100 ppm
Methyl-tert-Butyl Ether	1634-04-4	<16	NE	VE
1,2,4-Trinethyl Benzene	95-63-6	0.5-2.5	25 ppm (2)	25 ppm (2)
Isopentane	78-78-4	<20	NE	VE
n-Butane	106-97-8	<10	800 ppm	800 ppm

- (1) Areas covered by the Benzene Standard, 29 CFR 1910.1028, will have a 1 ppm 8 hour TWA and 5 ppm STEL
 (2) For Trinethylbenzene

NA Not Applicable NE Not Established

C. Personal Protection Information

Ventilation Use adequate ventilation to control concentration below recommended exposure limits

Respiratory Protection For concentrations exceeding the recommended exposure limit, use appropriate NIOSH/MSHA approved air purifying respirator. When entry into or exit from concentrations of unknown exposure, use NIOSH/MSHA approved self-contained breathing apparatus (SCBA)

Eye Protection Use safety glasses with side shields and face shield for splash protection

~~Skin Protection Use gloves resistant to the material being used (Viton, nitrile, neoprene) Use full-body, long sleeved garments to prevent skin contact~~

NOTE Personal protection information shown in Section C is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

D. Handling and Storage Precautions

Do not get in eyes, on skin or on clothing. Do not breathe vapors, mist, fume or dust. Do not swallow. May be aspirated into lungs. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Use only with adequate ventilation.

Keep away from heat, sparks, and flames. Store in a well-ventilated area. Store in tightly closed container. Bond and ground during transfer.

E. Reactivity Data

Stability	Stable
Conditions to Avoid	Not Applicable
Incompatibility (Materials to Avoid)	Oxygen and strong oxidizing agents
Hazardous Polymerization	Will Not Occur
Conditions to Avoid	Not Applicable
Hazardous Decomposition Products	Carbon oxides and various hydrocarbons when burned

F. Health Hazard Data

Recommended Exposure Limits

See Section B

Acute Effects of Overexposure

Eye May cause mild irritation with stinging and redness of the eyes

Skin May cause mild irritation. Repeated or prolonged contact may cause defatting of the skin, resulting in dermatitis

Inhalation May cause headache, nausea, weakness, sedation, and unconsciousness at high concentrations (>300 ppm)

Ingestion May be slightly irritating to intestines. May cause nausea. If swallowed, may be aspirated resulting in inflammation and possible fluid accumulation in the lungs. The oral LD50, rat, for unleaded gasoline is 18.8 ml/kg.

Subchronic and Chronic Effects of Overexposure

Unleaded gasoline has produced kidney cancer in male rats only. No comparable kidney disease is known to occur in humans.

Gasolines generally contain benzene which has been designated a carcinogen by the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), and the Occupational Safety and Health Administration (OSHA). Benzene may produce blood changes which include reduced platelets, red blood cells, and white blood cells. Also, aplastic anemia, and acute nonlymphocytic leukemia. Benzene has produced fetal death in laboratory animals and caused chromosome changes in humans and mutation changes in cells of other organisms.

Isopentane did not produce kidney damage in a subchronic oral laboratory study or in a subchronic inhalation exposure to 4500 ppm isopentane alone or 1000 ppm of a 50/50 mixture of isobutane and isopentane.

Exposure of pregnant rats during gestation to toluene at levels 250 ppm and higher produced some maternal toxicity and embryo/fetotoxicity. A lifetime inhalation study in rats did not show any toxic effects even at the high dose of 300 ppm.

Behavioural signs of hearing loss were observed in rats exposed to toluene subchronically at levels of 1000 ppm or more. Comparable effects have not been reported in humans.

Methyl-tert-butyl Ether (MTBE) is not readily absorbed through the skin and inhaled MTBE is rapidly eliminated from the body. Inhalation studies determined MTBE is not a neurotoxin, however, high concentrations (8000 ppm) can cause central nervous system depression. Inhalation of MTBE does not cause fetal malformations nor does it interfere with the reproductive capacity.

Ethylbenzene has caused fetotoxicity and liver and kidney injury in laboratory animals. No comparable injury has been reported in humans.

Liver and kidney changes have been noted in long term studies in animals exposed to xylenes. Fetotoxicity has been observed in animals with subchronic exposure to mixed xylenes at concentrations approximately five times the permissible exposure limit.

An epidemiology study of workers exposed to two isomers of trimethylbenzene had symptoms of nervousness, tension and anxiety, and asthmatic bronchitis. In addition, after inhalation of 60 ppm measured as hydrocarbon vapor, the workers' peripheral blood showed a tendency to hypochromic anemia and a deviation from normal in the coagulability of the blood.

Other Health Effects.

Combustion, a normal use of gasoline, results in an exhaust that has been associated with skin cancer in laboratory animals. Skin cancer was observed in these animals when exhaust was concentrated and repeatedly applied to the skin. This is not a normal route of exposure relevant to humans.

Combustion (burning) of most carbon-containing material forms carbon monoxide. Carbon monoxide inhalation may cause carboxyhemoglobinemia. Chronic exposure to carbon monoxide causes fatigue, poor memory, loss of sensation in fingers, visual disturbances and insomnia. Carboxyhemoglobinemia is frequently misdiagnosed as flu.

Sensitive sub-populations to the inhalation of carbon monoxide exist. Carbon monoxide displaces oxygen in the bloodstream and therefore can adversely effect people with pre-existing heart disease, pregnant women and smokers.

A Toxicity Study Summary for Toluene is available upon request.

A Toxicity Study Summary for Isopentane, Commercial Grade is available upon request.

Health Hazard Categories.

	Animal	Human		Animal	Human
Known Carcinogen	<u>X</u>	<u>X</u>	Toxic	—	—
Suspect Carcinogen	—	—	Corrosive	—	—
Mutagen	<u>X</u>	—	Irritant	—	—
Teratogen	—	—	Target Organ Toxin	<u>X</u>	<u>X</u>
Allergic Sensitizer	—	—	Specify - Blood Toxin, Reproductive		
Highly Toxic	—	—	Toxin-Embryo/Fetotoxin,		
			Lung-Aspiration Hazard		
			Kidney Toxin, Liver Toxin		

First Aid and Emergency Procedures

Eye	Flush eyes with running water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.
Skin	Wash skin with soap and water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.
Inhalation	Remove from exposure. If breathing is difficult, give oxygen. If breathing ceases, administer artificial respiration followed by oxygen. Seek immediate medical attention.
Ingestion	Do not induce vomiting. Seek immediate medical attention.
Note to Physician	Gastric lavage using a cuffed endotracheal tube may be performed at your discretion.

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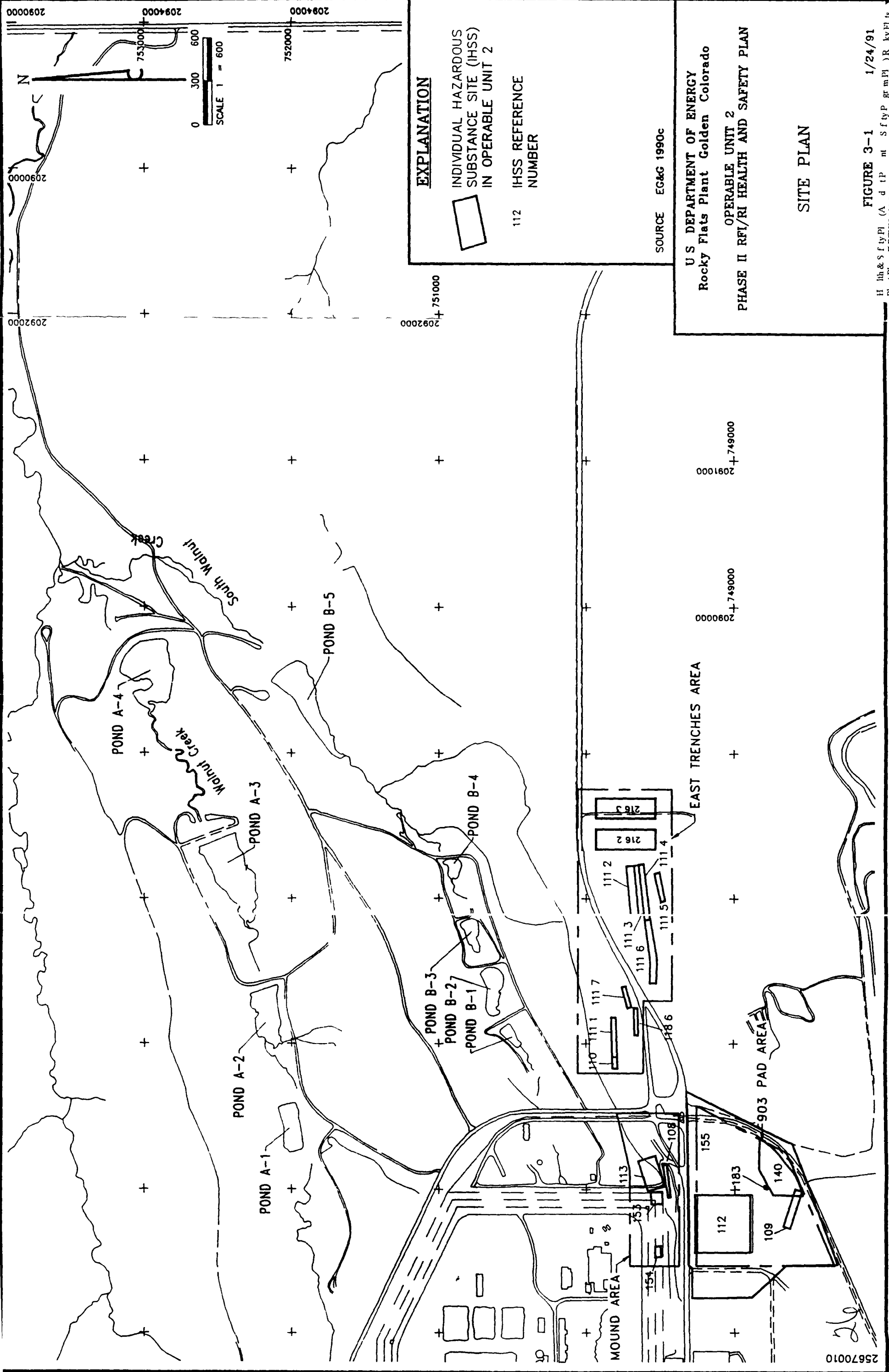


FIGURE 3-1 1/24/91

Health & Safety Plan (A d t p m S f ty P gr m p l) R ky Fl ts
Pl t Ph II RFI/RI 903 P d M nd d l: t T h Ar (Op bl U t
2) R ky Fl t Pl t Apr il 1991
D e m t C tr l N mb RFI/RI 903 P d M nd d l: t T h Ar (Op bl U t
EG&G Rocky Fl ts In